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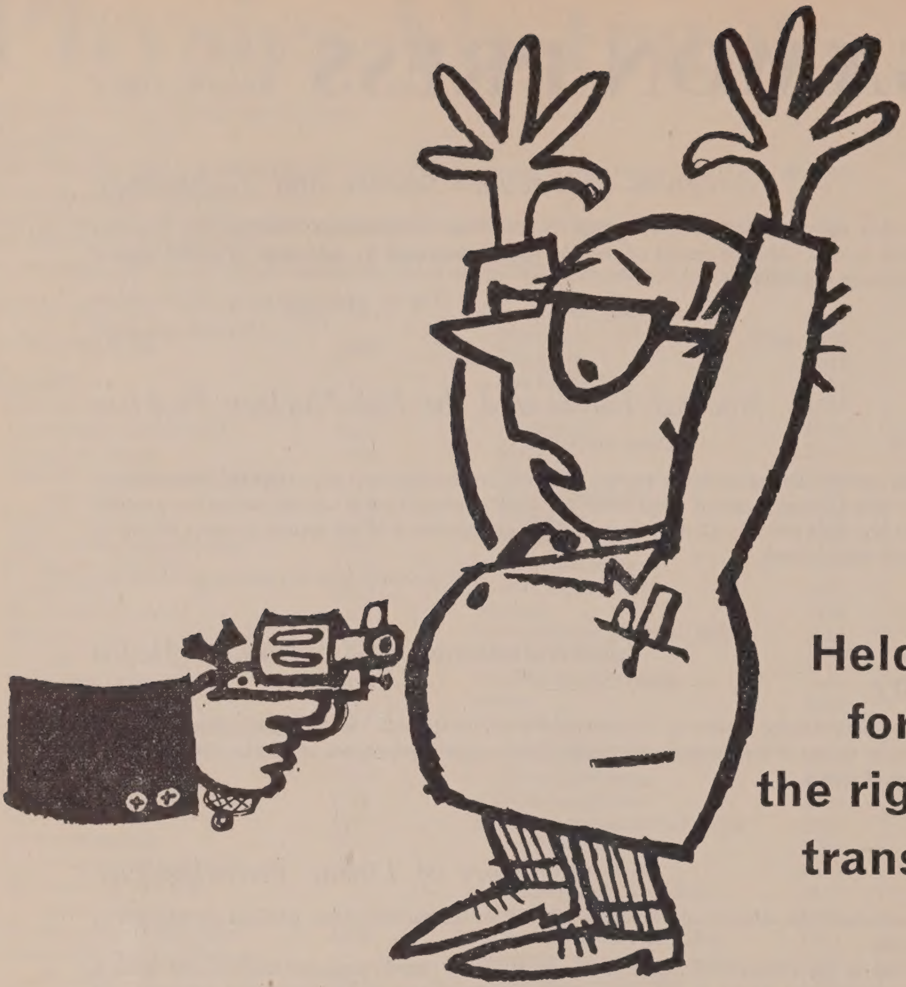

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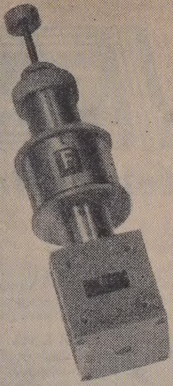

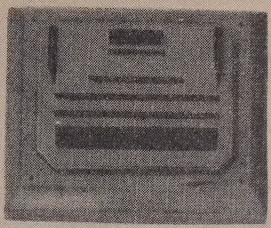

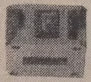

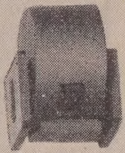

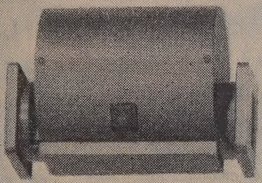

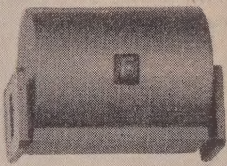

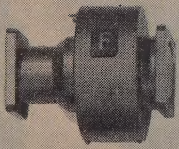

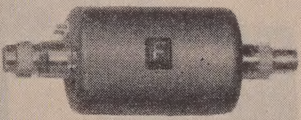

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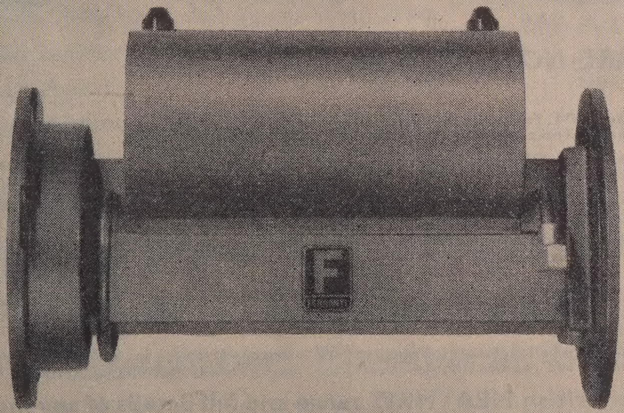

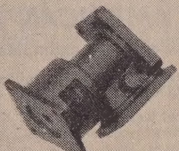

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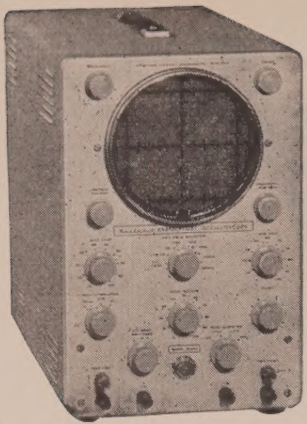
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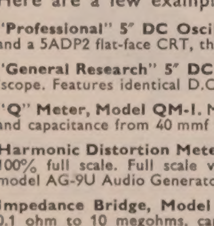
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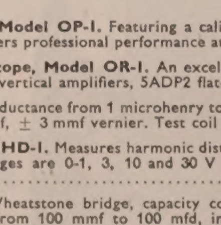
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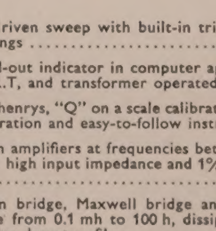
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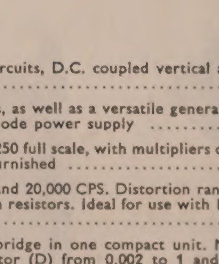
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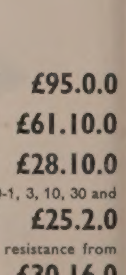
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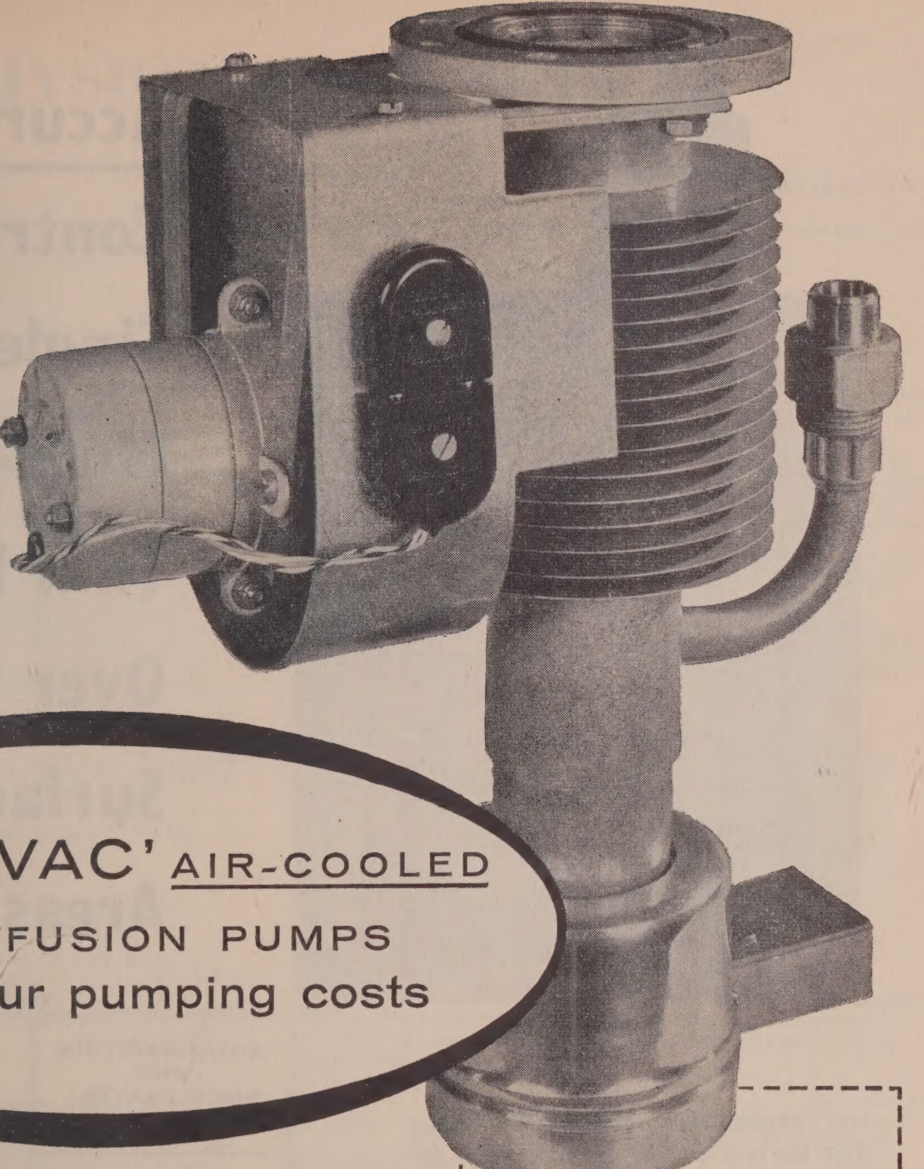

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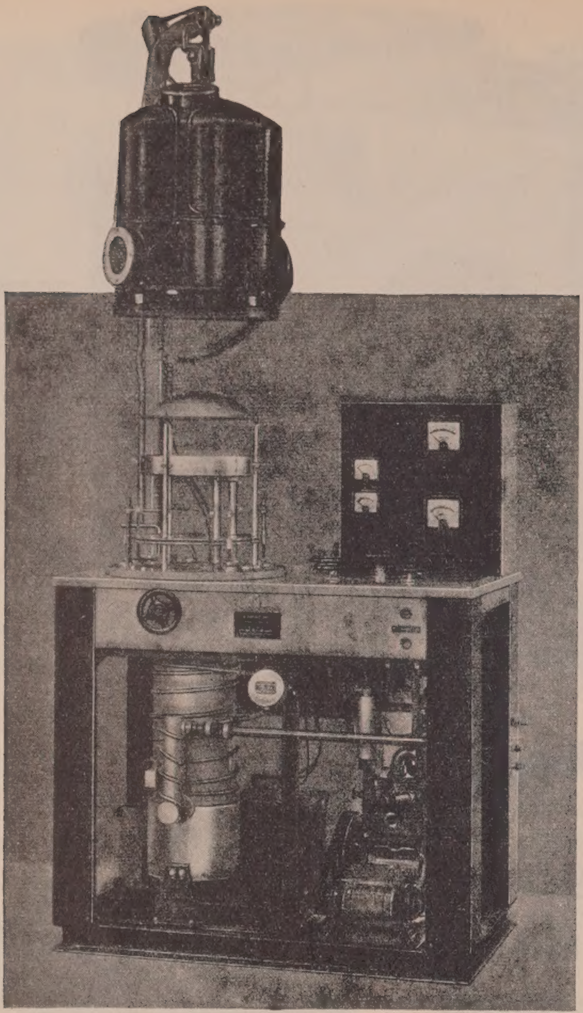

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14363 ON THE RADII OF FIVE PACKED SPHERES IN MUTUAL CONTACT. M.E.Wise.
hilips Res. Rep., Vol. 15, No. 2, 101-6 (April, 1960).

These results form part pf a study of close packing in spheres. ach of four given spheres touches the other three. The fifth interstitial") sphere touches all four externally and is usually irrounded by them. The other sphere touching all four either lies itside them or encloses them. These properties are shown by eometrical inversion. In this way a general equation relating to ie radii of five spheres in mutual contact is derived. Some general onclusions about different configurations of the five spheres are iscussed on the basis of this relation. The formulae are also xpressed in terms of statistical functions of the four radii; the olume of the tetrahedron of centres of the first four spheres is hown to be related to the same functions.

517 : 532.5

14364 LIMITING SOLUTIONS OF A NON-LINEAR EQUATION OF PARABOLIC TYPE.
.M.Zaidel' and K.A.Semendyaev.
okl. Akad. Nauk SSSR, Vol. 133, No. 2, 311-14 (July 11, 1960).
Russian.

The solution of the equation

$$\frac{1}{a} F_t = F[F_{rr} + (n - 1)r^{-1}F_r] + \frac{1}{k}(F_r)^2$$

and k are parameters; n = 1, 2, 3 for plane, cylindrical and pherical cases respectively; F = F(r,t); suffices denote derivatives) ending to the singular point r = t = 0, is of wave type. The solution considered in the phase plane; some solutions for n = 2 and 3, = 1 to 10 are plotted. J.K.Skwirzynski

517

14365 ELEMENTARY INTRODUCTION TO THE BESSEL, NEUMANN AND HANKEL FUNCTIONS. ESSENTIAL ROPERTIES OF THE CYLINDER-FUNCTIONS, WITH NUMEROUS XAMPLES OF APPLICATIONS IN PHYSICS AND TECHNOLOGY.
.Rehwald.
tuttgart: S.Hirzel Verlag (1959) 46 pp. [Mathematische Funktionen Physik und Technik. Band I]. In German.

This monograph contains a useful condensed account of the so-alled "cylinder-functions". Starting from the standard differential quation

$$\frac{d^2u}{dx^2} + \frac{1}{x}\cdot\frac{du}{dx} + (1 - \frac{n^2}{x^2})u = 0,$$

ith solutions $u(x) = C_1J_n(x) + C_2N_n(x)$ where C_1, C_2 are constants and $_n(x)$, $N_n(x)$ are Bessel and Neumann functions, respectively, of n-th rder, properties of these functions are described, with particular eference to comparison with the corresponding circular functions. hus, the parallelism of the Hankel functions

$$H_n^{(1)}(x) = J_n(x) + iN_n(x); H_n^{(2)}(x) = J_n(x) - iN_n(x)$$

ith the exponential $e^{\pm nix} = \cos nx \pm i \sin nx$ is pointed out. Next, e Bessel functions with imaginary argument (modified Bessel nctions) $I_n(y)$, $K_n(y)$ are defined; then the ber, bei, ker and kei functions are defined. A number of asymptotic expansions are given. There are complete sections on functions of order (integer $+\frac{1}{2}$), on Bessel functions with complex argument, and on the generating function $\exp[\frac{1}{2}z(t-t^{-1})]$, with other representations of the Bessel function. A large amount of basic information on Bessel, and related functions is given,together with examples of the application of these functions. N.L.Johnson

517 : 536

14366 A CLASS OF INHOMOGENEOUS BESSEL EQUATIONS. V.Vodička.
Z. angew. Math. Phys., Vol. 10, No. 6, 603-8 (1959). In German.

New particular solutions are given for certain types of nonhomogeneous Bessel equations. Their technical importance is illustrated by an example in heat conduction.

517

14367 A MATRIX METHOD OF REDUCTION OF THE GENERAL LORENTZ TRANSFORMATION [IN FOUR-SPACE INTO A PAIR OF COMPONENT PLANE ROTATIONS].
N.N.Ghosh.
Bull. Calcutta Math. Soc., Vol. 51, No. 3, 103-8 (Sept., 1959).

517 : 530.14

14368 ON THE MODIFICATION OF THE FEYNMAN'S "INTEGRAL-OVER-ALL-PATHS" METHOD.
J.Łopuszański.
Acta phys. Polon., Vol. 17, No. 2-3, 117-36 (1958).

Gives a modification of the mathematical formalism of Feynman's method (Abstr. 3107 of 1948), as well as an approximate solution of some problems in quantum mechanics and stochastic processes for large "time" intervals and a discrete spectrum of states. See also Abstr. 3629 of 1958.

517 : 530.14

14369 A TABLE OF HERMITIAN POLYNOMIALS FOR THE CALCULATION OF HARMONIC WAVE-FUNCTIONS.
R.Grandmontagne.
J. Phys. Radium, Vol. 19, No. 2, 153-8 (Feb., 1958). In French.

Logarithmic table with six figures of Hermitian polynomials and normalization factors for $2 \leq \nu \leq 30$. Twelve numbers are given for each unit in x.

517

14370 A VARIANT LEAST-SQUARES METHOD OF SOLUTION OF A SYSTEM OF OBSERVATION EQUATIONS.
J.L.Stearn and H.Richardson.
J. geophys. Res., Vol. 65, No. 4, 1308-9 (April, 1960).

A simple method for dropping an observation in the calculation of least-squares estimators of parameters. N.L.Johnson

518 : 536.3

NOMOGRAPHIC-TYPE SLIDE RULE FOR OBTAINING SPECTRAL BLACKBODY RADIATION DIRECTLY. See Abstr. 14879

517 : 551.5

A METHOD FOR ESTIMATING CONDITIONAL PROBABILITIES. See Abstr. 14186

ASTROPHYSICS

522 : 525

14371 VEHICLES AND PLANS.

N.G.Roman.

Astron. J., Vol. 65, No. 5, 240-1 (June, 1960).

Survey of methods for astonomical observations above the earth's atmosphere.

522.2

14372 SPACE TELESCOPES AND COMPONENTS.

L.Spitzer, Jr.

Astron. J., Vol. 65, No. 5, 242-63 (June, 1960).

A brief analysis is given of some of the major problems involved in the design of a large satellite telescope for stellar observations. A 1000 kg structure is assumed, 2 m on a side, in orbit at an altitude of either 800 km or 36 000 km, with orbital periods of 101 min and 24 hr, respectively. Stabilization during guiding requires countering the perturbing torques due to air drag, solar radiation pressure, the tidal force of the earth, and magnetic forces of ferromagnetic materials. The first three torques can be reduced by appropriate symmetry, and the last by use of iron with low permanent magnetization. A torque of 100 dyne cm should be adequate for stabilization. This torque can readily be produced by applying a rotating magnetic field to an "inertial sphere", consisting of an aluminium shell, positioned by a rapidly oscillation magnetic field. At 800 km the eddy currents in a sphere 40 cm in diameter, rotating in the earth's magnetic field, will transmit a torque as great as 100 dyne cm directly to the earth, and thus the sphere can continue to absorb a torque of this magnitude indefinitely. At an altitude of 36 000 km, the angular momentum accumulated by the sphere must be dumped in some way; jets of gas, and controlled magnetic and radiative torques provide possible means. To set the telescope, rotation of the entire satellite by as much as 180° in 6 min can be achieved either by an inertial sphere or by three separate wheels, one for each axis. To sense the direction in which the telescope points, for control of setting, a number of techniques are possible. Coarse orientation can be obtained by simple measures of the light from the sun and the infrared radiation from the earth; measurement of the direction of the earth's magnetic field and use of gyroscopes present alternate possibilities. If observations can be limited to stars of the fifth magnitude or brighter, the automatic guidance system can accept all light within a circle $\frac{1}{2}$ degree in radius, and the coarse orientation may suffice for initial acquisition, since the angle of the sun from the optical axis can easily be measured with considerable precision. For acquisition of fainter stars, the stars themselves must be used for fine orientation, either with television cameras and ground control, or by precise measures of angles from a few bright stars. Once a programme star or guide star has been acquired, automatic guidance with an accuracy better than a second of arc would appear entirely possible. Since storage batteries and electronic components are best kept at about 20° C, while photoelectric detectors should be cooled to −80° C for low dark current, a two-chamber satellite seems desirable. The satellite rotates about the optical axis automatically to keep the warm chamber facing the sun. Solar batteries producing a mean power of about 100 W are placed on this side. The other side comes into equilibrium with the infrared radiation from the earth and with the heat leakage from the warm chamber; a temperature between −65° and −95° C can be achieved. To maintain the focus and resolution of the optical system one may use fused silica mirrors, with a relative thermal expansion of less than 10^{-6} over this temperature range. For positioning the various optical elements, thermally compensated structures, using dissimilar metals, may be used. An arrangement of concentric tubes promises to yield the necessary thermal homogeneity required. Alternatively, the mirrors and all supports could all be made of aluminium, and conduction through sufficiently massive supports relied upon for thermal homogeneity. As an example of these concepts, a preliminary design is presented for a spectroscopic instrument, with a 24 in. mirror and a number of phototubes for scanning a stellar spectrum with high resolution. The overall reliability is investigated, on the basis of minimum failure rates for standard components. A mean life of about a year is computed before accumulating failures render the instrument unusable. The design includes considerably redundance of separate systems. If each electronic component could be made separately redundant, this mean life would be increased by an order of magnitude. Because of failures not envisaged in the analysis a number of separate launchings would presumably be required to yield a fully operating instrument.

5

14373 QUANTITATIVE TESTS OF THE LICK OBSERVATO 120-INCH MIRROR. N.U.Mayall and S.Vasilevskis.

Astron. J., Vol. 65, No. 5, 304-17 (June, 1960).

A description and numerical example are given of the metho developed for quantitative tests during the figuring of the Lick Observatory 120 in. mirror. The method represents a generaliz of the Hartmann test in which the image pattern is measured in both the radial and tangential directions. Combination of the rad and tangential profiles, by imposition of closure and intersection conditions, permits the construction of a contour map and yields complete evaluation of the concentration of light in the image. A the tests were made on stars with the telescope operated under r lar observing conditions. In the most favourable test, the mirro concentrated the light as follows: 70, 95 and 97% within image diameters of 25, 50 and 100 μ, or 0.34, 0.68 and 1.35 seconds of respectively. Depending on how the data are interpreted, the Hartmann constant ranges from 0.10 to 0.17 for this test.

14374 CONFERENCE ON ASTRONOMICAL OBSERVATION FROM ABOVE THE EARTH'S ATMOSPHERE.

Astron. J., Vol. 65, No. 5, 239-90 (June, 1960).

Introductory paper giving the aim of the conference which w sponsored by the American Astronomical Society and the Nationa Science Foundation and held at the Case Institute of Technology i Dec., 1959. Papers presented were as follows: Vehicles and Pl Space Telescopes and Components; Recent Experiments in Celes Mechanics; Solar Experiments; Stellar Astronomy from a Space Vehicle; Proposed Stellar and Interstellar Survey. Abstracts of these papers will be found in this issue of Physics Abstracts.

14375 THE SECOND ASTROMETRIC CONFERENCE.

Astron. J., Vol. 65, No. 4, 167-70 (May, 1960).

Introductory paper to the conference reports. The conferen was sponsored by the National Science Foundation and the Univer of Cincinnati and held at Cincinnati, May, 1959.

14376 REPORT ON THE FIRST INTER-AMERICAN CONFE ENCE ON ASTRONOMY AT LA PLATA AND CORDO OCTOBER 30 TO NOVEMBER 3, 1959. D.Brouwer.

Astron. J., Vol. 65, No. 4, 235-7 (May, 1960).

14377 RESOLUTIONS ADOPTED AT THE FIRST INTER-AMERICAN CONFERENCE ON ASTRONOMY HELD LA PLATA AND CORDOBA, OCTOBER 30 TO NOVEMBER 3, 19

Astron. J., Vol. 65, No. 4, 237-8 (May, 1960).

523 : 5

14378 SOME TOPICS IN MOLECULAR ASTRONOMY.

A.M.McKellar.

J. Roy. Astron. Soc. Canada, Vol. 54, No. 3, 97-109 (June, 1960).

Topics treated in this review include: the atmosphere of Ver and its time variation; CN bands in cometary spectra; N_2^+ band in spectra of high sunlit aurorae; diffuse interstellar lines; cool carbon stars, their opacity in violet and ultraviolet, their C^{12}/C^{13} ratio, and their singlet C_2 bands. J.Hawg

52

14379 ON A NEW APPROACH TO COSMOLOGY.

H.Nariai and Y.Ueno.

Progr. theor. Phys., Vol. 21, No. 2, 219-31 (Feb., 1959).

An attempt is made to develop a new theory of cosmology ba on a scalar field, in view of several weak points proper to the general relativistic cosmology. In this treatment, a kind of corr pondence principle plays the important role, together with the co sideration of the scope of applicability of general relativity. The cosmological field equation thus proposed not only has an intimat linkage with Einstein's equations, but also satisfies Mach's relat for the universe as a whole in a covariant and intrinsic manner.

523.12

4380 A NOTE ON CONTINUOUS CREATION.
C.de Turville.

rophys. J., Vol. 131, No. 3, 741-2 (May, 1960).
In current steady-state theories the rate of creation is assumed
e independent of the presence of local matter. A new creation
othesis is postulated, based on the non-destructive interaction of
utral H atom (in the ground state) and an antineutrino, resulting
he creation of a single neutron. The sequence of subsequent
mic chain reactions is as follows:
ation: H atom + antineutrino → H atom + antineutrino + neutron
ay: Neutron → proton + electron + antineutrino
ombination: Proton + electron → H atom
net result being the formation of 2 H atoms and 2 antineutrinos.
ticular consequences of the above reactions are: (1) for a steady-
e, an exponential rate of creation must be accompanied by an
onential expansion of space; (2) bulk cosmic matter is electrical-
eutral since neutron-decay liberates positive and negative
rges at equal rates; (3) cosmic abundances of H are very large
tive to the combined abundances of all other elements, i.e. neutral
nic H is a major constituent of the inter-galactic gas. A simple
erimental test of the theory is proposed which involves the
ection of nascent neutrons from a hot gas torch operated in an
nse antineutrino flux from a nuclear reactor. D R.Barber

523.14

14381 A STUDY OF THE INTERPLANETARY IONIZED GAS, ENERGETIC ELECTRONS AND THE CORPUSCULAR DIATION OF THE SUN BY MEANS OF 3-ELECTRODE LLECTORS FOR CHARGED PARTICLES IN THE SECOND VIET COSMIC ROCKET.
.Gringauz, V.V.Bezrukikh, V.D.Ozerov and R.E.Rybchinskii.

kl. Akad. Nauk SSSR, Vol. 131, No. 6, 1301-4 (April 21, 1960).
Russian.
Details of the construction and layout of the apparatus, which
s chosen to discriminate between the three most probable models
the interplanetary medium, are given. Discussion of the results
ds to the following conclusions: (1) At distances up to 4 earth
lii, there exists a plasma with temperature not greater than
000°; (2) From 55 000 to 75 000 km there is a stream of electrons,
density ~ 10^8 cm^{-2} sec^{-1}, and energies > 200 eV; (3) Near the
on, the rocket passed through a stream of positive ions (probably
tons), density ~ 2 × 10^8 cm^{-2} sec^{-1}, energies > 15 eV.
G.A.Chisnall

523.16 : 621.396.969.3

14382 RADAR ASTRONOMY SYMPOSIUM REPORT.
R.L.Leadabrand.

geophys. Res., Vol. 65, No. 4, 1103-18 (April, 1960).
A symposium was held at San Diego in October 1959, as part of
technical programme of the United States National Committee of
International Scientific Radio Union. The subjects discussed
luded radar studies of the moon, sun and planets; radar studies
the exosphere and interplanetary medium and radar echoes from
teors and aurorae.

523.16

14383 THE SOURCE OF RADIATION FROM JUPITER AT DECIMETER WAVELENGTHS. II. CYCLOTRON DIATION BY TRAPPED ELECTRONS. G.B.Field.

geophys. Res., Vol. 65, No. 6, 1661-71 (June, 1960).
One of the mechanisms previously suggested (see Abstr. 8471 of
60) which could account for the decimeter radiation from Jupiter
examined in detail. A model is proposed in which nonrelativistic
ectrons are trapped on a magnetic surface in Jupiter's magnetic
ld, in analogy with the outer radiation belt of the earth. The
ectrum and polarization of the cyclotron radiation emitted as the
ctrons move through the inhomogeneous magnetic field are calcu-
ed. The form of the spectrum $(\lambda^{1/3})$ compares well with the
served one, and the required electron densities are only 0.3% of
se observed in the belt around the earth. The required magnetic
ld is very large — at least 1200 G at the poles. It is found that
polarization of the 20 Mc/s bursts can be explained if the lati-
le of the emitting region is between 30° and 40°. A suggestion is
de about the origin of those bursts in electrical discharges. It
shown that the large magnetic field may be primordial, owing
the high electrical conductivity throughout the planet. Obser-
ional tests related to the proposed mechanism are discussed.

523.16 : 551.5

PRE-SC POLAR CAP IONOSPHERIC BLACKOUT AND TYPE
SOLAR RADIO OUTBURST. See Abstr. 14222

523.16 : 621,396.969

14384 ROUGHNESS OF THE MOON AS A RADAR REFLECTOR
V.A.Hughes.

Nature (London), Vol. 186, 873-4 (June 11, 1960).

The angular scattering properties of the moon have been measured at a wavelength of 10 cm using the 2 MW radar transmitter in the 45 ft diameter radio telescope at Malvern employing a pulse length of 5 μsec corresponding to a range resolution of 0.75 km. The measured law of scattering is consistent with scattering from a rough surface which has irregularities much greater than a wavelength and a horizontal scale equivalent to about twenty times the vertical deviations. Comparison with sea echoes indicates that the reflectivity of the moon lies between 10^{-1} and 10^{-2}. It is suggested that for other planets the reflectivity is greater and the total scattering area of a planet approximately equal to the projected area. C.Hazard

523.16 : 551.5

14385 THE SIMULTANEOUS OBSERVATION OF RADIO STAR SCINTILLATIONS ON DIFFERENT RADIO-FREQUENCIES. H.J.A.Chivers.

J. atmos. terrest. Phys., Vol. 17, No. 3, 181-7 (Feb., 1960).

A comprehensive study of the phenomenon of radio star scintillations has been made over the range 26 Mc/s to 408 Mc/s, by recording simultaneously on at least two frequencies within this frequency range. With records obtained over a wide range of scintillation conditions, it has been possible to test the theoretical laws governing the frequency dependence of scintillation amplitude and rate. It is established that under extreme conditions these laws no longer hold. A study of the probability amplitude distribution of scintillations covers a wide range of mean scintillation amplitudes. The smaller scintillations have a Gaussian or Rayleigh amplitude distribution, but with increasing scintillation activity, discontinuities appear in the distribution obtained. Under the most intense conditions a nett attenuation of the source is observed. The cross-correlation coefficient between records has been determined over a frequency ratio of 3 : 1 and the results are compatible with those of other workers.

523.16

14386 COSMIC RADIO SOURCES AS INTERGALACTIC COLLISIONS. G.A.Harrower.

Astrophys. J., Vol. 132, No. 1, 22-9 (July, 1960).

Counts of observed sources of various apparent intensities, assumed to refer to a homogeneous universe, provide a relation between source density and average source intensity. Source density is calculated as the density of intergalactic collisions, and this value, used in the relation just mentioned, permits calculation of the average source intensity. Next, the fraction of the kinetic energy of the colliding gas, which must be converted to radio energy in order to produce this source intensity, is estimated. Finally, two calculations are made of the maximum distance reached by present radio surveys, the first based on the calculated density of sources and the number of sources observed and the second based on the measured intensity of the weakest sources and the calculated value of average source intensity. The effects on these various values of clustering of the galaxies is considered briefly.

523.16

14387 A SURVEY OF RADIO STARS AT A FREQUENCY OF 38 Mc/s. G.R.Whitfield.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 6, 581-8 (1960).

Describes a survey of small diameter radio stars made with an interferometer at 38 Mc/s. The positions and flux densities of 59 radio stars, all of which are confirmed by other surveys, are given in the catalogue.

523.16

14388 THE EFFECT OF TRAIL IRREGULARITIES ON THE INTERPRETATION OF METEOR ECHOES.
A.G.McNamara and D.W.R.McKinley.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 156-9 (Oct., 1959).

A brief discussion of some points raised in a recent paper by Manning on obliquely-scattered meteor echoes is followed by the suggestion that the initial distribution of ionization along a typical meteor trail is markedly irregular. Several tentative hypotheses are advanced to account for the irregularities.

523.16

14389 METEOR RADIANT DISTRIBUTIONS AND THE RADIO-ECHO RATES OBSERVED BY FORWARD SCATTER.

M.L.Meeks and J.C.James.

J. atmos. terrest. Phys., Vol. 16, No. 3-4, 228-35 (Nov., 1959).

The diurnal variations in sporadic meteor echo rate observed by the forward scattering of radiowaves over three different paths are compared with predictions based on a simplified model of the average radiant distribution which has been obtained from radar data by Hawkins. The simplified distribution is composed of three hypothetical meteor showers with radiants at the apex of the earth's way and at points in the ecliptic at angles ±65° from the apex. Reasonably good agreement is found between these predictions and extensive measurements reported by Vogan and Campbell. Additional measurements reported here for two paths—Boston, Massachusetts to Atlanta, Georgia (1480 km) and Boston, Massachusetts to Columbia, South Carolina (1250 km)—also show similar agreement. Evidence of the concentrations of radiants near the sun and antihelion points appear in the average diurnal rate for periods of about 1 month. In general forward-scatter measurements appear consistent with Hawkins' radiant distribution.

523.16

14390 A THEORY FOR DETERMINING UPPER-ATMOSPHERE WINDS FROM RADIO OBSERVATIONS ON METEOR TRAILS.

G.V.Groves.

J. atmos. terrest. Phys., Vol. 16, No. 3-4, 344-56 (Nov., 1959).

Least-squares theory is applied to observations on drifting meteor trails to obtain the determination of a general number of parameters, characterizing the wind structure. The results enable vertical air motion and time- and height-variations in the wind structure to be examined, whereas previously a constant horizontal wind was assumed. It is shown how, on the basis of the least-squares solution, the errors in the parameters, and hence in the calculated wind structure, can be estimated. The method is applied to a typical set of data.

523.16

14391 THE AZIMUTH DISTRIBUTION OF OBLIQUE REFLECTIONS FROM METEOR TRAILS AND ITS RELATION TO METEOR RADIANT DISTRIBUTIONS.

W.C.Bain.

J. atmos. terrest. Phys., Vol. 17, No. 3, 188-204 (Feb., 1960).

Azimuth distributions of the meteor reflections to be excepted at various times of day on a 1740 km north-south transmission path at v.h.f. are calculated from three initial radiant distributions of sporadic meteors. These distributions were: (1) a distribution of meteors, magnitude about 7, obtained by workers at Jodrell Bank; (2) a uniform heliocentric distribution in the plane of the ecliptic; (3) a heliocentric distribution uniform over the celestial sphere. It was found that the third of these gave the best fit to the azimuth results obtained by Meadows (1958) on such a path at a frequency of 37 Mc/s; the meteors observed extended downwards in intensity to magnitude 10. Calculations on the forward-scattering of radio waves by meteors should therefore be based on this distribution. Observational results are also presented for a very similar path with a frequency of about 70 Mc/s; they resemble those obtained at 37 Mc/s, although are not identical to them. The cause of the differences is unknown, but they may be due to the transmitter polar diagram not being identical at the two frequencies.

523.16 : 523.5

METEOR VELOCITIES FROM CONTINUOUS-WAVE RADIO DIFFRACTION EFFECTS FROM TRAILS.

See Abstr. 14403

523.2

14392 DIRAC'S COSMOLOGY AND THE ORIGIN OF THE SOLAR SYSTEM.

L.Egyed.

Nature (London), Vol. 186, 621-2 (May 21, 1960).

Postulating the conservation of angular momentum and a gravitational constant decreasing with time, it is noted that, under suitable conditions, there would be an instant at which the centrifugal force at the solar equator became equal to the surface gravity. It is suggested that a planetary mass, escaping at this instant, would lead to a decrease in the solar radius and a repetition of the process. The proposed mechanism might lead to the successive formation of planets and could account for Bode's law. R.A.Newing

523.2

14393 ORIGIN OF THE SOLAR SYSTEM.

M.M.Woolfson.

Nature (London), Vol. 187, 47-8 (July 2, 1960).

A new hydrodynamical model is proposed to explain the origin of the solar system. A star of mass = 100 solar masses approac the sun at a velocity of 100 km/sec to within 10 solar radii. Initially the sun is assumed to be in rotation about an axis outsid the orbital plane of the approaching star. A solar tidal bulge ens the height of which increases as the distance between sun and sta decreases. When the gravitational pull exerted by the disturbing body on the apex of the solar bulge exceeds that on the remainder the solar mass, this portion breaks away to form the outermost planet, Pluto. Thr loss of this material sets up surface waves th travel round the solar surface from the opposite tidal bulge to th facing the oncoming star: the latter eventually draws off another solar mass to form the planet Neptune. In this manner successiv surface waves are able to effect the release of sufficient materia form the outer planets up to the asteroid belt. As the star reced from the sun, Mars, earth, Venus and Mercury are formed in tur As the time required for each tidal wave to travel a distance equa to half the solar circumference will be ~ 80 min, all the requisite material will be separated from the parent body in ~ 12 h. Unlik others preceding it, the present model is capable of giving a quali tative interpretation of the major observational data and physical characteristics of the solar system. D.R.Bar

523.2 :

14394 NUCLEAR COSMOCHRONOLOGY.

W.A.Fowler and F.Hoyle.

Ann. Phys. (New York), Vol. 10, No. 2, 280-302 (June, 1960).

In the studies described in this paper quantitative use is mad of the radioactive decays of uranium and thorium in cosmochron logy in much the same manner as these decays have been employ in geochronology. The paper is divided into two quite different pa representing different views as to the immediate source of the m erial that now constitutes the solar system.

Model 1. The Autonomous Galaxy. From its orgin, the Gala has been an autonomous system—no further important additions material from inter-galactic space have taken place at subsequen times. Star formation, stellar evolution, and nucleosynthesis hav declined at a steady exponential rate over the whole lifetime of th Galaxy. The duration of nucleosynthesis is found to be independe of this rate over rather wide limits.

Model 2. Steady-State Cosmology and Galactic—Intergalactic Exchange of Matter. The abundance of the elements in intergalac matter has reached a steady state through interchange with galax in which stars produce elements beyond hydrogen. As a conseque of this same point of view, the Galaxy acquired significant quantit of intergalactic material at various times. This occurred particu larly about one billion years before the sun and solar system was formed. Except at epochs of addition of new gas, stellar activity declined exponentially, as in Model 1. Consideration of the decay the radioactive isotopes Th^{232}, U^{235}, U^{238}, according to Model 1, le to the conclusion that the age of the Galaxy is $15^{+5}_{-3} \times 10^9$ years. Similar considerations according to Model 2 lead to the conclusio that the expansion time scale of the universe (the reciprocal of the Hubble constant H) is $11 \pm 6 \times 10^9$ years. The error can be reduc to $\pm 2 \times 10^9$ years if the present thorium—uranium ratio is chose to give a Pb^{208}/Pb^{206} age for the solar system concordant with that given by Pb^{207}/Pb^{206}, namely 4.5×10^9 years. Applications to the chronology of the Galaxy can no longer be made in a simple manne but the age found in the Model 1 calculations would seem to be a lower limit.

523

14395 SOLAR TERRESTRIAL RELATIONSHIPS.

K.D.Cole.

Nature (London), Vol. 186, 874 (June 11, 1960).

A considerable body of evidence now exists to suggest that bo proton and electron densities in interplanetary space are considerably lower than the frequently assumed value of $10^3/cm^3$. Indeed, the interplanetary magnetic field is ~ 10^{-4} gauss, and the density as low as 1 proton/cm^3 solar hydromagnetic waves can be continuously propagated from sun to earth thus providing the requisite source of energy for geomagnetic and high-latitude auroral activit A theory based on this supposition is briefly outlined. D.R.Barb

523

14396 SOME CALCULATIONS ON THE THERMAL HISTORY OF THE MOON.

B.Yu.Levin and S.V.Maeva.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 44-7 (July 1, 1960).
In Russian.

The outline of a calculation (similar to those done for the ear of the internal temperature due to heat given out by the radioactiv elements. J.M.Hou

523.4

14397 HIGH-DISPERSION SPECTRA OF JUPITER.

C.C.Kiess, C.H.Corliss and H.K.Kiess.

rophys. J., Vol. 132, No. 1, 221-31 (July, 1960).

In May, 1957, the spectrum of Jupiter was photographed with cave gratings of high dispersion at the Slope Observatory at ana Loa. The spectrograms covered the region from 3600 to 0 A. Tables are presented listing the wavelengths and estimated nsities of lines that make up the structures of the ammonia ds at 6450 and 7900 A and of the methane bands at 6200, 7250, 0, and 8620 A. In the infrared, four lines of the (3,0) band in the drupole rotation—vibration spectrum of H_2 were measured. In violet and ultraviolet regions of the planet's spectrum a conous absorption was recorded that closely resembles the conous absorption of the nitrogen tetroxide molecule.

523.4 : 551.5

14398 DENSITY OF NEUTRAL GAS IN A PLANETARY EXOSPHERE.

J.C.Brandt and J.W.Chamberlain.

ys. of Fluids, Vol. 3, No. 3, 485-6 (May-June, 1960).

A problem previously treated by Öpik and Singer (Abstr. 835 of 0) is reconsidered. A treatment of particles in ballistic orbits y, based on Boltzmann's equation without collisions, leads to a mula different from Öpik and Singer's. Moreover, numerical imates are given indicating that the collision rate greatly exceeds ionization rate at two earth radii, and that therefore satellite its should also be included; it is claimed that in this case the ocity distribution will be a Maxwellian one truncated at the ape velocity. The predictions of the various formulae are mpared graphically. O.Penrose

523.4 : 551.5

14399 DISTRIBUTION OF DENSITY IN A PLANETARY EXOSPHERE.

E.J.Öpik and S.F.Singer.

ys. of Fluids, Vol. 3, No. 3, 486-8 (May-June, 1960).

A reply to the criticisms by Brandt and Chamberlain (see eceding abstract) of previous work by the authors. A corrected rsion of the authors' original density distribution formula is en. This formula includes both elliptic and hyperbolic ballistic its, whereas in Brandt and Chamberlain's formula, hyperbolic its are neglected. The two formulae agree numerically out to earth radii. Reasons are given for thinking that the rate of loss atoms in satellite orbits may be large enough to make satellite its negligible. O.Penrose

523.5

14400 ASTEROIDAL FRAGMENTS.

G.S.Hawkins.

stron. J., Vol. 65, No. 5, 318-22 (June, 1960).

The meteorite catalogue of Prior and Hey was used to determine e rate of fall and mass distribution of meteorites. An analysis for e United States and Europe shows that 3.3 meteorites with a mass 10 kg reach the earth per day. The cumulative number with mass eater than or equal to a chosen value m varies as 1/m. This law lds for stone finds and falls and iron falls. The iron finds include excess of larger objects, attributed to selection effects on the ound. If this influx has been constant, the earth has collected the uivalent of an asteroid 14 km in diameter during the last 5×10^9 ars. It is estimated that the asteroids consist of 16.7% by weight nickel—iron, indicating a primary object that before breakup was termediate in size between the moon and Mars. The space density meteorites is shown to vary as $(\text{radius})^{-4}$ and the total mass of eteorites with radius between 1 cm and 1 km is at least $.6 \times 10^{-24}$ g cm^{-3}. The size distribution of particles produced by e crushing of rock is similar to that found for meteorites and ggests that meteorites undergo a considerable number of collisions space.

523.5

14401 THE DENSITY AND MASS DISTRIBUTION OF METEORITIC BODIES IN THE NEIGHBORHOOD OF THE ARTH'S ORBIT.

H.Brown.

. geophys. Res., Vol. 65, No. 6, 1679-83 (June, 1960).

A study of the frequency of meteorite falls in areas which have een highly populated throughout the last century indicates that the verage rate of fall of meteorites on the earth probably lies between .32 and 1.0 falls/year/10^6 cm^2. The frequency of fall as a function f type and mass has been studied, and it is shown that the distriution curves for stones and irons have similar shapes. The curves re also remarkably similar to those observed for asteroids. The observed relationships are used to calculate the impact frequency of meteoritic particles upon the earth and moon as a function of their size.

523.5

14402 ABUNDANCES OF THE RARE-EARTH ELEMENTS, LANTHANUM TO LUTETIUM IN CHONDRITIC METEORITES.

R.A.Schmitt, A.W.Mosen, C.S.Suffredini, J.E.Lasch, R.A.Sharp and D.A.Olehy.

Nature (London), Vol. 186, 863-6 (June 11, 1960).

Abundances of all the stable rare-earth elements, from La to Lu, were determined in two chondritic meteorite samples (Allegan and Richardton) by the new and powerful neutron activation technique using a neutron flux of 2×10^{13} neutrons/cm^2. Results are tabulated, and expressed in grams rare earth per 10^6 grams meteoritic material. Compared with Noddack's earlier (1937) data obtained by X-ray spectroscopy, the present results differ by about ±30%; and abundances of the even atomic number elements are larger (by a factor of ~ 4) than those of the odd atomic number elements. A smooth decrease in abundance is found for both series from A = 137 to A = 150. Between A = 150 and A = 170 the decline is halted by a smooth perturbation with peak at A = 163. D.R.Barber

523.5 : 523.16

14403 THE CALCULATION OF METEOR VELOCITIES FROM CONTINUOUS-WAVE RADIO DIFFRACTION EFFECTS FROM TRAILS.

J.S.Mainstone.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 6, 517-29 (1960).

The theory of continuous-wave radio diffraction effects from meteor trails is reviewed and it is shown that the zone lengths corresponding to the pairs of maxima of the echo waveform used for velocity measurements depend on the phase relationship between the ground wave and the wave reflected from the trail. Large errors can arise if no account is taken of this phase relationship. A new method of analysis for c.w. echoes is proposed and a comparison is made with other methods. It is shown that with this method it is possible to measure meteor orbits with a c.w. system. A discussion of the factors affecting the accuracy of measurements made with new equipment at Adelaide is given, together with some preliminary results.

523.5

14404 THE POYNTING—ROBERTSON EFFECT.

G.Guigay.

J. Phys. Radium, Vol. 20, No. 4, 494-503 (April, 1959). In French.

Let a particle move in the Sun's gravitation field. According to Poynting and Robertson the radiation pressure is not exactly directed along the straight line Sun—particle, but possess a component opposite to the particle's velocity. A simplified demonstration is given for the case of a solar electromagnetic radiation and for that of a corpuscular radiation. It is shown that the semi-major axis and the eccentricity of the orbit of the particle decrease continually: the particle spirals into the Sun. For a particle of 10^{-2} cm radius and a density of 4, the time of fall is about 10^5 years. For constant density this time is proportional to the radius. A study is given of the effects on the distribution of the orbits in a meteoric current, on the zodiacal cloud, and on the capture of meteoric bodies by the earth.

523.5

14405 COMMENT ON THE AGE OF THE ELEMENTS.

P.Eberhardt and J.Geiss.

Z Naturforsch, Vol 15a, No 5-6, 547 (May-June 1960)

Possible explanations of the discovery that the isotopic composition of xenon in the chondrite Richardton is different from that of atmospheric xenon are discussed. C.F.Barnaby

523.6

14406 THE EXCITATION MECHANISM OF THE SWAN BANDS OF COMETS.

A.Stawikowski and P.Swings.

Ann. Astrophys., Vol. 23, No. 4, 585-93 (1960). In French.

The high resolution spectrograms of Comet Mrkos (1957d) reveal the essential features of the rotational structure of the Swan bands. Intensity anomalies observed within the (1-0) and (2-1) transitions are due to the presence of absorption lines in the exciting solar radiation. It is thus proved that the Swan bands are excited by fluorescence, although their lower level $^3\pi_u$ is not the ground electronic state of C_2.

523.7

14407 RECENT PROGRESS IN SOLAR PHYSICS.

W.O.Roberts and H.Zirin.

J. geophys. Res., Vol. 65, No. 6, 1645-59 (June, 1960).

A number of significant recent advances in solar physics are reviewed. New kinds of observations made during the present sunspot cycle, which began in 1954, have emphasized still further the apparent complexity of solar phenomena and the need of non-equilibrium theoretical treatments. Among the new developments discussed are solar cosmic rays and high-energy particles, flares and prominences, coronal condensations, solar magnetic fields, and solar radio noise emission. Theoretical analyses of the conditions of the solar atmosphere as a hot plasma, and a gaseous ensemble exhibiting gross departures from thermodynamic equilibrium, are discussed. New work on atomic collisional parameters is also reviewed. A synopsis of certain major unsolved problems of the solar atmosphere is given.

523.72 : 537.59

14408 MOTIONS OF SOLAR COSMIC RAYS AND THE PROPERTIES OF THE GENERAL MAGNETIC FIELD OF THE SUN. K.Sakurai.
J. Geomagn. Geoelect., Vol. 11, No. 1, 21-33 (1959).

From solar magnetic observations, it seems that the sun has a magnetic field of dipole character such that the intensity is about one gauss in the polar latitude regions and its polarity is inverse that of the earth. If this field results from a magnetic dipole that the sun may have, the value of this dipole moment is estimated as about 5×10^{33} gauss cm^3. On the assumption that the magnetic field from this dipole spreads into the outer space surrounding the sun, the orbits of the solar cosmic-ray particles have been calculated based on some additive assumptions.

523.72

14409 DIRECT ABSORPTION OF SOLAR RADIATION BY ATMOSPHERIC WATER VAPOR. J.E.McDonald.
J. Meteorol., Vol. 17, No. 3, 319-28 (June, 1960).

A review of Fowle's solar-absorption studies reveals that no pressure corrections must be applied to the familiar Fowle band-absorptivity curves since these were obtained by methods that automatically corrected them to sea-level pressures. Using these absorptivities, along with recent solar-energy-distribution data, total insolational absorptivities are obtained. These are fitted (with relative accuracy of about 1% over the range 0.3 to 8.0, precipitable water) to an exponential function similar to that used by Mügge and Möller (1932) to obtain working relations for use in calculating daily heating amounts due to insolational absorption by water vapour. It is found that variation of the pressure exponent from zero to unity in trial pressure-correction laws yields only a 6% variation in total columnar absorption for a concrete case. Estimates accurate to within about 10% with respect to the Fowle absorption data are attainable for levels below about 400 mb in humid regions. However, clarification of the method employed by Houghton in arriving at his roughly 30% greater absorptivities leaves doubt as to the status of the familiar Fowle absorptions, so it is concluded that it is not possible to predict insolational heating rates to better than about 30% absolute accuracy.

523.74

14410 COMMENTS ON WARWICK'S PAPER ON THE FORMATION OF ABSORPTION LINES IN A SUNSPOT. W.Unno.
Ann. Astrophys., Vol. 22, No. 5, 430-5 (1959).

Warwick's paper (Abstr. 4663 of 1958) is found to be incorrect in the derivation of the transfer equation for the Zeeman components. A set of transfer equations is newly derived in terms of the intensity parameters, and is found to be equivalent to the set of transfer equations derived by the author in terms of the Stokes parameters. Simple examples show that Warwick's equations are invalid.

523.74

14411 OBSERVATIONS ON THE RELATION BETWEEN ERUPTIONS AND SUNSPOT FIELDS. A.Bruzek.
Z. Astrophys., Vol. 50, No. 2, 110-20 (1960). In German.

Within one large spot group, there developed three great flares on June 16, 17 and 18, 1959, and three 3+ flares on July 10, 14, and 16. The relations between the development of these flares and the spot and its magnetic field were studied. It was found that: (1) The great flares appeared during periods of slowly and continuously proceeding important changes in spot and magnetic field structure. No connection could be found between any special phase of spot development and onset of great flares. (2) In spite of considerable changes in the spot structure all the flares originated at the same position relative to the spot umbrae and had almost the same shape. (3) The great flares and most of the minor ones originated at the edges of umbrae and near or on the "neutral line" of zero longitudinal magnetic field strength. This means that the flares originated in regions of strong magnetic fields — frequently with a strong or predominant transverse component — but never in "neutral poin of zero field strength.

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14412 OBSERVATIONS OF THE SOLAR PHOTOSPHERE. I. A TECHNIQUE FOR PHOTOGRAPHIC OBSERVAT (23 cm OBJECTIVE). J.Rösch.
Ann. Astrophys., Vol. 22, No. 5, 571-83 (1959). In French.

Dependable data about the photosphere are needed for check the theory of stellar atmospheres. Observations from balloons been undertaken, along with a series of observations at the Pic d Midi Observatory. Description is given of the instrument (23 cm refractor, narrow spectral range around 5950 A), of the care taken avoid, as far as possible, the effects of atmospheric turbulence (focal plane cooling, operating rules), of the exposure technique (24 frames per second during a few seconds, every 30 or 60 seco and of the various types of record obtained (granules and sunspot

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14413 OBSERVATIONS ON THE SOLAR PHOTOSPHERE. II. COUNTS AND PHOTOGRAPHIC PHOTOMETRY GRANULES IN THE SPECTRAL DOMAIN 5900-6000 A.
J.Rösch.
Ann. Astrophys., Vol. 22, No. 5, 584-607 (1959). In French.

Gives results obtained from photographs of the photosphere (see preceding abstract). Counts of granules on composite pictu the total number of granules on the photosphere, taking into acc the fainter ones, is found to be about 3.5×10^6. An estimate of t mean distance between centres of granules (2" 0) is considered a more significant than the ill-defined "diameter". An estimate, fr one microphotometer tracing, of the r.m.s. in brightness (3.5%). drawing of an isophotal map, showing the bright regions predomi over the dark ones. Tracing of mean profiles of granules and po (dark regions of granular size) and estimate of the mean relative difference of brightness (11.7%). Correction for diffraction, lead to a brightness of granules in excess of 23% (mean value) over th background.

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14414 CHARTS OF THE BALANCE AND ABUNDANCES IN THE STELLAR AND SOLAR PHOTOSPHERES. I. THE SPECTRUM OF NEUTRAL TITANIUM — CHARTS OF LOCAL THERMODYNAMIC EQUILIBRIUM. J.C.Pecker.
Ann. Astrophys., Vol. 22, No. 5, 499-526 (1959). In French.

The combined use of equivalent widths and central intensitie allows an easy computation of the abundances together with the departures from local thermodynamic equilibrium. In the case of neutral titanium, those departures are high, for the lowest multip Thus, the conclusion is that the classical value of the abundance (determined assuming local thermodynamic equilibrium) is very largely underestimated.

523

14415 CHARTS OF THE BALANCE AND ABUNDANCES IN STELLAR AND SOLAR PHOTOSPHERES. II. THE CASE OF NEUTRAL ATOMS OF TITANIUM, VANADIUM, AND CHROMIUM IN THE SOLAR ATMOSPHERE.
J.C.Pecker and L.Vogel.
Ann. Astrophys., Vol. 23, No. 4, 594-621 (1960). In French.

The very different behaviour, at the same depths in the solar photosphere, of equal excitation lines of equal ionization potential atoms (Ti, V, Cr) in the proof of the fact that non-local thermody equilibrium effects are, for the considered atoms and layers, mo important than the inhomogeneities effects. Moreover, it is not t choice of the model which is responsible for the observed phenom

523

14416 CHARTS OF THE BALANCE AND ABUNDANCES IN THE STELLAR AND SOLAR PHOTOSPHERES. III. CHARTS OF LOCAL THERMODYNAMIC EQUILIBRIUM IN T 4300 BAND OF CH (THE SOLAR CASE).
F.Eugène-Praderie and J.C.Pecker.
Ann. Astrophys., Vol. 23, No. 4, 622-32 (1960). In French.

The method described in the preceding abstracts is applied t the case of the 4300 A band of CH. Large departures from local thermodynamic equilibrium are found: the excitation temperature are about 300° higher than the electron temperatures. However t values found by the authors are "not entirely incompatible" with classical determinations of the rotation temperatures. Moreover the present calculations permit a correct interpretation of limb-darkening observations.

523.74

14417 THERMODYNAMIC STRUCTURE OF THE OUTER SOLAR ATMOSPHERE. VI. EFFECT OF DEPARTURES OM THE SAHA EQUATION ON INFERRED PROPERTIES OF THE W CHROMOSPHERE. S.R.Pottasch and R.N.Thomas.

rophys. J., Vol. 132, No. 1, 195-201 (July, 1960).

For earlier work see Abstr. 9763 of 1960. The methodology of t preceding treatment of the Saha equation under conditions of high man continuous opacity has been applied to a reanalysis of the tinuous emission from the lowest chromosphere. The result is reatly steepened T_e-gradient, relative to the results of an earlier lysis based on the neglect of non-LTE effects.

523.74

14418 PROPERTIES OF THE SOLAR WIND DURING SUNSPOT MINIMUM. A.L.Licht.

geophys. Res., Vol. 65, No. 5, 1397-1400 (May, 1960).

Parker's model of a spherically expanding corona, the solar d,is compared with Blackwell's observations of the 1954 minimum atorial corona [Monthly Not. Roy. Astron. Soc., Vol. 116, No. 1, (1956)]. A significant discrepancy is found between the predicted the observed electron densities at distances from the sun greater n 20 solar radii. Blackwell's data are found to be consistent h a model in which the corona expands mostly within a thin disk, thickness less than 25 solar radii, and lying within the sun's atorial plane. The thickness of the disk as a function of distance m the sun is qualitatively explained in terms of magnetic pressure.

523.74 : 550.3

14419 SOLAR ACTIVITY AND GEOMAGNETIC K-INDEX AT SUNSPOT MINIMUM.

Hatanaka, Z.Suemoto and A.Tsuchiya.

p. Ionosphere Res. Japan, Vol. 9, No. 1, 51 (March, 1955).

A short note as follows: Relations between the solar activities d geomagnetic K-index were studied for the period 1951-1953 en the solar activity was minimum. The results are: (1) The ensity of the green line of the corona at the east limb is minimum out 10 days before the K-index is maximum when the mean values e taken for both for several solar rotations. (2) The K-index minimum 3 days after the meridian passage on the sun of a large nspot with a strong magnetic field. (3) The K-index is maximum to 6 days after the meridian passage of a pair of sunspots on e sun when the pair is defined as two spots each having a magnetic eld stronger than 1000 gauss and are separated not more than degrees on the solar surface. (4) No remarkable correlation found between the K-index and dark filaments. The results) and (3) were also confirmed for the preceeding period of the nspot minimum during 1941-1942.

523.74 : 551.5

14420 A RELATIONSHIP BETWEEN THE LIFE OF M-REGIONS AND THE RATE OF CHANGE OF SOLAR TIVITY. D.W.G.Chappell.

atmos. terrest. Phys., Vol. 17, No. 4, 315-19 (Feb., 1960).

To test the hypothesis that the observed lack of success in fore-sting disturbances to radio propagation by using the recurrence ttern during the 1953-1954 sunspot minimum period is due to the gh rate of decay of the 1953-1954 cycle of solar activity, magnetic aracter figures for the period 1890-1950 were examined. A nu-erical definition of "persistence of recurrence" is given and a ear relationship is obtained between the maximum value of this antity at sunspot minimum and the rate of decay of solar activity that minimum. The extremely low value of this quantity predic-d by this relationship for the 1954 sunspot minimum period is con-dered to provide confirmatory evidence for the initial hypothesis.

523.74 : 551.5

FURTHER EVIDENCE OF A SOLAR CORPUSCULAR FLUENCE ON LARGE-SCALE CIRCULATION AT 300 mb.

523.75

14421 THE Hα LINE IN THE CHROMOSPHERE. R.Michard.

nn. Astrophys., Vol. 22, No. 5, 547-70 (1959). In French.

New observations of the chromospheric Hα line have been made ith the 9 m solar spectrograph in Meudon. An height-sequence of pectra, with an image every 730 km, has been analysed; profiles the line on and outside spicules have been compared as a function height. Above 5 to 6000 km the Hα line on spicules has a pure oppler profile with a mean width (at half-intensity points) of 1.2 A, e range being 0.8 to 1.8 A for different spicules. Under 5000 km this profile is more and more affected by a central absorption (simulating self-absorption) which very rapidly increases to strong self-reversal. This means that under 5000 km spicules are embedded in a gas strongly absorbing Hα, with an absorption profile narrower than that of spicules, and re-emitting this line with a smaller source-function. The quantitative interpretation of the profiles of both isolated spicules and the chromosphere as a whole, has led to a determination of the Hα source-function, optical depth and abundance of spicules down to 1000 km, and also of the source-function of interspicular material. But the absorbing properties of this material could be found only approximately.

523.75

14422 A RELATIONSHIP BETWEEN SOLAR RADIO NOISE STORMS AND CHROMOSPHERIC ERUPTIONS.

A.M.Malinge.

Ann. Astrophys., Vol. 23, No. 4, 574-84 (1960). In French.

Comparison of the position of radio noise storms observed at 169 Mc/s with solar flares following or preceding the beginning of the noise storms shows a definite relation between the two phenomena. A notable effect of refraction is shown to exist in the corona.

523.75

14423 PROMINENCE CHARACTERISTICS IN REGIONS OF BRIGHT CORONAL EMISSION.

N.C.Gantvoort and D.E.Billings.

Astrophys. J., Vol. 132, No. 1, 213-17 (July, 1960).

Prominences showing a high degree of fragmentation and large internal motions are found to be most prevalent in regions of high coronal density. The relative prevalence of other types of prominence in such coronal regions is also considered. It is concluded that prominences which carry matter in greatest quantities from the corona to the solar surface are those which are located within regions of high coronal density.

523.75

14424 THE HYDRODYNAMIC TREATMENT OF THE EXPANDING SOLAR CORONA. E.N.Parker.

Astrophys. J., Vol. 132, No. 1, 175-83 (July, 1960).

It has been argued elsewhere that the earlier hydrodynamic treatment of the solar corona, which predicted a steady 500 km/sec expansion, was incorrect and that the appropriate treatment of the mass loss to the solar corona is with the classical evaporation theory of Jeans et al. The singular properties of the solutions of the hydrodynamic equations have been investigated and show that the only stationary solution appropriate to the solar corona is the critical solution, which passes straight across the critical point and yields supersonic (500 km/sec) expansion at infinity. Also it is shown that the evaporative solutions are incompatible with the hydrodynamic equation and hence incompatible with the Boltzmann equation.

523.75

14425 OBSERVATIONS OF A PERSISTENT CORONAL JET. J.L.Leroy.

Ann. Astrophys., Vol. 23, No. 4, 567-73 (1960). In French.

Observations of the solar corona in white and in monochromatic light, made with new instruments at Meudon and Pic du Midi Observatories, have shown that a large polar streamer existed during the fall of 1959. It was present during at least three months. Monochromatic emissions appeared only around the bottom of the streamer.

523.75

14426 THE TEMPERATURE OF THE SOLAR CORONA. A.Unsöld.

Z. Astrophys., Vol. 50, No. 1, 48-56 (1960). In German.

A review of available methods of measuring the temperature of the inner corona, and a discussion of results. The most recent determinations yield values between 1.7 and 2.4 × 10^6 °K, depending on the method employed. D.R.Barber

523.75

14427 STRUCTURE AND VARIATIONS OF THE SOLAR CORONA. A.Unsöld.

Z. Astrophys., Vol. 50, No. 1, 57-68 (1960). In German.

A theoretical discussion of energy considerations as applied to the model corona in an attempt to explain the mechanism of coronal rays and condensations, and the slow variation of the solar centimetre radiation of thermal origin. D.R.Barber

523.75 : 551.5

14428 ON THE CURRENT SYSTEM OF SOLAR-FLARE EFFECTS.

J.Veldkamp and D.van Sabben.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 192-202 (June, 1960).

The electric current system responsible for the great solar flare effect of 23 March 1958 is compared with the currents of the normal daily variation of the geomagnetic field. Whereas the standard S_q-currents are symmetric with respect to the geographic equator, the pattern of the currents of the solar flare effect as well as that of the currents of the normal daily variation at the time of it are controlled by the magnetic equator. It is shown that these currents must flow in a region where the disappearance of electrons follows an attachment law. The decrease of the solar flare effects leads to a loss coefficient $\beta = 5 \times 10^{-4}$ sec^{-1}, which compares with the known value for the D-layer.

523.75

14429 MAGNETIC FIELDS ASSOCIATED WITH THE SOLAR FLARE OF JULY 16, 1959.

R.Howard and H.W.Babcock.

Astrophys. J., Vol. 132, No. 1, 218-20 (July, 1960).

Fourteen "fine-scan" magnetograms at intervals of 15 minutes were obtained during the progress of a large solar flare on July 16, 1959. The pattern of magnetic fields associated with the flare showed no changes other than minor effects attributable to seeing and imperfections in scanning.

523.76

14430 THE STRUCTURE AND MAGNETIC FIELD OF THE SOLAR CORONA.

J.A.Högbom.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 6, 530-9 (1960).

Observations of the radio star Taurus-A when it passed close to the sun in June 1958 have shown that the scattering of radiowaves in the solar corona is highly anisotropic and this is interpreted in terms of irregularities aligned in the general magnetic field of the sun. The direction of the field can thus be investigated, and has been found to be approximately radial between 10 and 30 solar radii. The scattering irregularities can be regarded as an extension of the fine structure seen on eclipse photographs. The anisotropic scattering also provides a possible explanation of the observed variations of integrated intensity from the radio star at closest approach. It is suggested that the corona at maximum phase is expanding and that the observed radial field is the result of localized fields from the surface being carried out in the corona by the expanding gas. The typical polar field at sunspot minimum could then be caused by a consistent N—S asymmetry in the localized fields during the preceding maximum phase. When the extreme minimum corona of the 1954 eclipse is treated as a magnetohydrostatically stable configuration, the surface field strength at the poles can be calculated. The result, 1.5 G, agrees well with the photospheric measurements by Babcock.

523.77

14431 THE MEASUREMENT OF THE LOCAL DOPPLER SHIFT OF FRAUNHOFER LINES.

L.Goldberg. O.C.Mohler, W.Unno and J.Brown.

Astrophys. J., Vol. 132, No. 1, 184-94 (July, 1960).

Well-defined spectra showing the Doppler shift arising from small-scale motions in the solar atmosphere were obtained with the vacuum spectrograph of the McMath-Hulbert Observatory during August and September, 1955. These spectra have been measured, and the local Doppler shifts of several solar absorption lines have been determined at various positions on the disk of the sun. The average value of the random turbulent velocity is found to be 0.33 km/sec for elements with an average diameter of 5.5 sec of arc (4000 km). However, the values of the random turbulent velocity, as well as other characteristics, show systematic differences between weak and strong lines. Metallic lines formed at average effective optical depths, $\bar{\tau}(5000)$ larger than 0.2, show smaller velocities than the average. Their r.m.s. velocities monotonically increase toward the limb of the sun ($1.0 > \mu > 0.6$). Stronger lines ($\tau_{5000} < 0.2$) show systematically larger values of the r.m.s. velocities with no appreciable centre-to-limb variation. Near the limb of the sun ($\mu = 0.35$) all the measured lines show smaller r.m.s. velocities than at $\mu = 0.58$. This may be caused by lack of resolution of small elements in the neighborhood of the solar limb. These results suggest that the large-scale motion in the upper photosphere decreases as the limb of the sun is approached. They also suggest that a rising element of the atmosphere is statistically followed by a falling element in the same region.

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14432 DEPTH OF FORMATION IN THE SOLAR SPECTRU I. THE APPLICATION OF INVERSION TO THE LAPLACE RELATION.

S.Dumont and J.C.Pecker.

Ann. Astrophys., Vol. 23, No. 4, 655-67 (1960). In French.

A new method for the inversion of the relation

$$I_\nu(\mu) = \int_0^\infty S_\nu(\tau) e^{-\tau/\mu} \frac{d\tau}{\mu}$$

is suggested using the definition $I_\nu(\mu) = S_\nu[\tau^*(\mu)]$ for the depth formation τ^*. Tables of τ^* are prepared for three development of $S(\tau)$. The new method and classical method are applied to a t problem. The comparison shows that the new method is an impr ment. Finally, a method is given for correcting the residuals: $\Delta I = I_{observed} - I_{computed}$.

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14433 A STUDY OF THE SPECTRA TAKEN BY BERNARD LYOT AT THE KHARTOUM ECLIPSE ON 28th FEBRUARY 1952. I. EXPERIMENTAL RESULTS.

L.Divan and C.Pecker.

Ann. Astrophys., Vol. 23, No. 4, 541-66 (1960). In French.

Results of the studies of the Lyot spectra taken with a slit spectrograph (6700 - 4000 A; 4800 - 3300A) are given under 4 m headings. (1) Variation of the coronal line intensities with latit (Öhman's method). (2) Measurements of equivalent widths for th strongest coronal lines in a coronal condensation. (3) Study of a prominence located on the West limb of the sun during the eclips (4) Identification, intensities of the emission lines, measurement the Balmer discontinuity.

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14434 SOLAR EXPERIMENTS.

L.Goldberg.

Astron. J., Vol. 65, No. 5, 274-7 (June, 1960).

Owing to the well-known negative temperature gradient in the solar atmosphere, the solar chromosphere and corona emit stro in the far-ultraviolet and X-ray regions of the spectrum, as has already been revealed by observations from rockets. The highly energetic events connected with solar flares also result in stron emissions at very short wavelengths. Hence, solar experiments from satellites will have high priority in the astronomy space pr gramme. Design work has been begun on the development of sol instrumentation to be flown in a series of vehicles with progressively larger payloads. The first experiment is being designed fo vehicle that can carry instruments up to a weight of about 100 lb that will be stabilized with a pointing accuracy of a few minutes arc. Two scanning spectrometers will be employed, one coverin the spectral region from 1600 to 500 A and the other from 600 to 75 A. The resolving power would be about 1 A, and the spectrometers would have a combined weight of about 45 lb. It is also h that some type of X-ray imaging device will be flown in the first vehicle. Plans are also being developed for the installation of a small solar observatory with a variety of instruments totalling a 600 or 700 lb, exclusive of stabilization gear, power supply and storage, etc.. The instruments would include a high-dispersion spectrometer operating in the region from 3000 to 75 A, one or n spectroheliometers to register images of the sun in Lyman-α an other monochromatic radiations, an X-ray telescope and spectrometer, and equipment for the observation of low-frequency radio emission from the sun. Finally, it is pointed that a number of important problems in solar physics can be solved better by obse ations from balloons rather than from satellites. These include studies of the hydrodynamic and magnetic properties of the solar photosphere, and observation of the infrared solar spectrum.

523

14435 EMISSION CORES IN THE Ca II LINES IN PLAGES.

E. van P.Smith.

Astrophys. J., Vol. 132, No. 1, 202-12 (July, 1960).

Some of the observed characteristics of the emission cores a presented, which any theory of the line formation of the H and K lines must account for. The several correlations found from the are summarized in a table. A range of a factor of 3 in the emissi line width occurs on the sun between such different features as su spots and plages near the limb. The relevance to the Wilson—Ba effect is discussed. Another parameter investigated is the separ of the emission peaks. This is not uniquely related to the width a in fact, behaves differently in certain respects. Whereas, for ance, the emission-line width in plages exceeds that of the neigh- ng quiet disk, the separation of the peaks is less in plages than he normal disk. The separation is inversely proportional to the nsity of either K_3 or K_2. The width, on the other hand, behaves in ore complex fashion. There exists a very high correlation be- en the K_3 and K_2 intensities. The intensity of the K_1 absorption beyond the emission core depends somewhat on the intensity of emission, though the variation within a single plage and from e to plage is very much less. This fact, as well as the centre- imb variations of their profiles, suggests that plages are restric- to a thin layer in the chromosphere with little effect on the tem- ature structure of the underlying photosphere.

523.77

14436 RESEARCH INTO THE RESONANCE LINE OF Fe X THE SOLAR ULTRAVIOLET SPECTRUM.

C.Pecker.

. Acad. Sci. (Paris), Vol. 250, No. 23, 3779-81 (June 8, 1960). In nch.

Both resonance lines of Mg X seem to be present in the solar aviolet spectrum, though not with the intensities predicted by olley and Allen. The identification of a strong line at λ 344.7 A erms of the O III ion is disputed, since other strong lines of this are not observed. An alternative identification in terms of a onance transition $(3s3p^{6}\,{}^{2}S_{1/2}-3s^{2}3p^{5}\,{}^{2}P^{0}_{3/2})$ in the coronal ion Fe X supported by theoretical estimates of wavelength and intensity. other strong line of Fe X $(3s3p^{6}\,{}^{2}S_{1/2}-3s^{2}3p^{5}\,{}^{2}P^{0}{}_{1/2})$ should appear 365 A but its presence is not confirmed. K.A.Thomas

523.77

14437 THE BEHAVIOUR OF THE MONOCHROMATIC CORONA IN THE 11-YEAR CYCLE.

M.Waldmeier.

Astrophys., Vol. 50, No. 3, 145-54 (1960). In German.

The author's coronal measurements at the Arosa observatory v cover two cycles. The present paper deals with the total ission of the coronal lines 5303 and 6374 A — defined as the n of all intensities measured along the solar limb at a distance about $\frac{1}{2}'$ — for the years 1939 to 1959. The emission of the line 03 A follows the spot-curve with great amplitude and its extremes ncide with those of the sunspots. The emission of the line 6374 A nearly independent of the phase of the cycle. Its small fluctuations y be described as a double wave, and a maximum of the 6374 A ission appears when the spots show either a maximum or a nimum. The pronounced 11 year period of the line 5303 A is due the fact that the electron density as well as the temperature are her during the spot maximum than during the minimum and with ir increase the intensity of the line rises too. On the other hand, as emission of the line 6374 A diminishes with increasing tempera- e, the variations influenced by the density and the temperature nost compensate each other. The small maximum coinciding h the spot maximum is caused by the increased density, that curring at the same time as the spot minimum by the low nperature.

523.8

14438 STELLAR ASTRONOMY FROM A SPACE VEHICLE.

A.D.Code.

tron. J., Vol. 65, No. 5, 278-84 (June, 1960).

Space research in stellar astronomy will initially concentrate observations in the vacuum ultraviolet and X-ray region. Future servations will be substantially aided by a series of general sky rveys in the ultraviolet both by rocket flights and satellite observ- ions. This paper describes some of the stellar observations that ight prove most profitable in the light of current astrophysical owledge. The topics discussed fall under the following headings: . Ultraviolet and infrared survey studies; B. Stellar energy dis- ibution; C. Stellar spectroscopy; D. Interstellar medium; . Extragalactic studies, and F. High resolution studies.

523.8

14439 PROPOSED STELLAR AND INTERSTELLAR SURVEY.

F.L.Whipple and R.J.Davis.

stron. J., Vol. 65, No. 5, 285-90 (June, 1960).

Previous planning for the design, construction and operation of astronomical telescope in a satellite orbit was presented by embers of the Smithsonian Astrophysical and Harvard College bservatories (1959). Further elaboration of these plans is pre- ented, including possible systems for measuring bright-line radia- on of the interstellar medium and obtaining slitless spectra of ars, as well as a broad survey of the entire sky in three colours etween 1000 and 3000 A. With the support of the National Aero- autics and Space Administration the design programme is under way at the Smithsonian Astrophysical Observatory. Plans are also developing for an Aerobee rocket firing in late 1960 or early 1961 in which a T.V. image-tube system covered by a multicolour mosaic filter can produce a preliminary shallow survey of both nebulosity and bright stars over a strip of the sky some 150° and 4°. Since the rocket will be neither precisely stabilized nor controlled at high altitudes, the exact position of the observational strip can only be approximated. Direct image photographs of stars and nebulosity, however, will be available in spectral regions from below Lyman-alpha to approximately 2000 A. The Westinghouse Electric Corporation has undertaken the development of special materials for T.V. image tubes sensitive to spectral regions in the far u.v. The precise spectral regions in which the rocket and satellite experiments will be conducted depend upon these developments. The astrophysical significance is discussed of the proposed experiments in the regions of Lyman-alpha and above for stars and interstellar material.

523.8

14440 THE ROLE OF ABSORPTION LINES IN PHOTOELECTRIC WIDE PASS-BAND PHOTOMETRY.

A.M.Rozis-Saulgeot.

Ann. Astrophys., Vol. 23, No. 4, 504-15 (1960). In French.

Studies their effect on the magnitudes, the colour indices and in the case of reddened stars, on the colour excesses. Their effect on the measurements of interstellar absorption is also discussed.

523.8

14441 PHOTOMETRY OF R CANIS MAJORIS.

R.H.Koch.

Astron. J., Vol. 65, No. 5, 326-36 (June, 1960).

Photoelectric light curves of R CMa have been obtained in three colours and have yielded a common solution of the orbital elements. Peculiarities of the light curves are pointed out and discussed.

523.82

14442 THE INTENSITY INTERFEROMETER AND ITS APPLICATION TO THE MEASUREMENT OF THE DIAMETER OF STARS.

R.H.Brown.

J. Phys. Radium, Vol. 20, No. 11, 898-906 (Nov., 1959). In French.

A general theoretical analysis has been completed of the principle of intensity interferometry and of its application to astronomy in a stellar interferometer, and experiments to check this theory have been carried out. It is believed that the technique will make a valuable contribution to astronomy in the measurement of the angular diameter of hot stars and it is proposed, subject to the outcome of the design study, that a stellar interferometer should be built with a maximum baseline of 200 m and with sufficiently large mirrors to enable it to work on all stars of magnitude greater than +3.

523.84

14443 NOTE ON THE H-R DIAGRAM OF BINARY STARS.

E.A.Kreiken and B.Süer.

Ann. Astrophys., Vol. 23, No. 4, 528-40 (1960). In French.

An attempt has been made to determine the evolutionary tracks of stars from the distribution in the H-R diagram of the components of binary stars of which the less massive is on the main sequence. Only some envelopes can be constructed to which these evolutionary tracks should be tangential. The shapes of these envelopes suggest that with the early stars the tracks are horizontal, while with the late stars steep tracks prevail. This would be in accordance with theory, but the observational evidence is not conclusive. An inspection of possible evolutionary tracks for individual components with well determined masses leads to controversial results.

523.84

14444 THE SPECTRAL AND LUMINOSITY ANOMALY OF SECONDARY COMPONENTS OF EARLY-TYPE SPECTROSCOPIC BINARIES.

Su-Shu Huang.

Ann Astrophys., Vol. 22, No. 5, 527-39 (1959).

As a result of the spectral and luminosity anomaly of some double-lined spectroscopic binaries, it is suggested that the secondary atmosphere is heated by the corpuscular radiation from the primary star. The corpuscular radiation from the stars, like that from the sun, may originate in stellar flares, the existence of which explains also the structure of spectral lines discovered in one of these binaries, i.e. α Virginis.

523.84

14445 EVOLUTIONARY MASS EXCHANGE IN CLOSE BINARY SYSTEMS.

D.C.Morton.

Astrophys. J., Vol. 132, No. 1, 146-61 (July, 1960).

Observations have found many close binary systems with one component near the main sequence and the other a subgiant filling its lobe of the Roche limit, but it is always the secondary and never the primary that fills its limit. This situation can be explained in terms of the primary evolving, first, to the Roche limit and then transferring most of its mass to the other star, so that the roles of primary and secondary are interchanged, leaving the new secondary filling its limiting lobe. It is shown that the transition is fast enough that very few systems will be caught making it. Plotting Roche limits of typical systems on an HR diagram shows that the primary component in most systems can reach its limit only in the Hertzsprung gap, where even normal evolution is comparatively fast. For the case in which the primary expands to the Roche limit during the early evolutionary phase, calculations are made for the effect of mass loss on the radii of various stellar models and for the effect of mass transfer on the size of the limiting surface. For all models in thermal equilibrium, though not for the one in only hydrostatic equilibrium, the primary lobe of the limit shrinks faster than the star, demonstrating that the process must be unstable on a Kelvin time scale.

523.84

14446 THE MOTION OF GAS STREAMS IN CLOSE BINARY SYSTEMS. K.H.Prendergast.

Astrophys. J., Vol. 132, No. 1, 162-74 (July, 1960).

An approximate solution of the equations of hydrodynamics has been obtained for the flow of gas in the vicinity of a close binary system, under the assumption that the pressure terms in the equations of motion are small compared with the gravitational, centrifugal, and Coriolis forces. It is shown that the Jacobi integral has a hydrodynamic analogue and that the existence of this integral makes possible an elementary solution of the equation of continuity. It is assumed that hydrostatic support prevails in the direction normal to the orbital plane, and it is shown that the gaseous envelope is thin unless the mean-square turbulent velocity is comparable to the orbital velocity of the stars. The velocity has been computed for the case $\mu = 0.25$, and the flow pattern has several features in common with the empirical models which have been constructed to explain the observations.

523.84

14447 A COLOR-MAGNITUDE DIAGRAM OF HIGH VELOCITY DOUBLE STARS. G.Wallerstein and J.Westfall.

Astron. J., Vol. 65, No. 5, 323-5 (June, 1960).

A colour-magnitude diagram of high velocity stars has been compiled using absolute magnitudes obtained from dynamical parallaxes. All visual binaries in Miss Roman's Catalogue (1955) which show sufficient orbital motion are included. The main sequence is well populated with stars redder than $B-V = 0.55$. Of eight stars lying above the main sequence, five lie close to the giant branch of M67. Two stars lie significantly above that line and one lies below it. The system ADS 10938, which has been reported by Eggen and Sandage (1959) to be a member of the Groombridge 1830 group, is discussed in some detail.

523.84

14448 THE NOVA OUTBURST. I.

S.Pottasch.

Ann. Astrophys., Vol. 22, No. 4, 297-309 (1959).

A discussion of the essential observations which comprise the nova phenomenon is given with special reference to six well observed novae. A summary is given of the important modern interpretations with a criticism of the plausibility and consistency of these arguments. From these arguments, a likely, simple shell model of the nova outburst is chosen as the basis for subsequent analysis. The model is examined to decide whether it can adequately, in a semi-quantitative way, reproduce the observation, and if it can, whether it is the only model which can do so.

523.84

14449 THE NOVA OUTBURST. II. THE RADIATIVE COOLING OF AN EXPANDING SHELL. S.Pottasch.

Ann. Astrophys., Vol. 22, No. 4, 310-17 (1959).

A detailed study of the transfer of radiation in a shell which is subject to the radiation of a hot star located at the centre of the shell. The shell is assumed to be expanding at a constant rate. The subsequent cooling of the shell when it is opaque to visible radiation is given. It is shown that the surface luminosity and temperature of the shell as a function of time match the novae light curve and temperature variation over the same period of time. This analysis may have application to many other problems besides the nova shell.

52

14450 THE NOVA OUTBURST. III. THE IONIZATION OF HYDROGEN GAS BY AN EXCITING STAR.

J.Jefferies and S.Pottasch.

Ann. Astrophys., Vol. 22, No. 4, 318-40 (1959).

The ionization of hydrogen gas by an exciting star is consid The extent and sharpness of the boundary of the ionized region a found, taking into account not only the direct ionizing radiation f the exciting star, but the scattered (diffused) ionizing radiation a well. The scattered radiation is found by solving the transfer ec ation, for which the source function is rigourously derived. The sults obtained are compared to the theory given by Strømgren, w does not explicitly take into account the scattered ionizing radiat It is shown that the linear extent of the ionized region predicted Strømgren is too small by a factor of at least 10 in the density range 10^6-10^{14} atoms per cm^3. At densities lower than 10^4 atom per cm^3 (diffuse nebulae) two effects tend to reduce the amount o scattered radiation and reduce the discrepency with the Strømgr theory to less than a factor of 2. Four examples are discussed i detail.

52

14451 THE NOVA OUTBURST. IV. THE INTENSITY OF $H\alpha$

S.Pottasch.

Ann. Astrophys., Vol. 22, No. 5, 394-411 (1959).

The electron density and electron temperature of the shell a a function of time is determined for six well observed novae. Tl is done by considering the hydrogen line emission over the entir period it is observed, coupling this information with the observa of [O III]. In addition to n_E and T_E as functions of time, the hydr mass of five of the nova shells is determined, and the time when ionizing radiation penetrates the shell is found. This last quanti directly related to the change of the spectrum at this date from "principal" to "nebular" and is also related to the fluctuations in the light curve.

52

14452 THE NOVA OUTBURST. V. THE TEMPERATURE AN RADIUS OF THE CENTRAL EXCITING STAR AND OBSERVATION OF ELEMENTS OTHER THAN HYDROGEN.

S.Pottasch.

Ann. Astrophys., Vol. 22, No. 5, 412-25 (1959).

The temperature and radius of the central star (the actual no is determined for six novae over the period beginning somewhat after maximum and extending until the nova shell is optically thi hydrogen ionizing radiation. During this period the temperature found to remain roughly constant while the radius appears to dec The temperatures are determined using a variation of Zanstra's method. The energies emitted by stars with these temperatures radii are computed for the period until the shell becomes optical thin to H ionizing radiation and these energies are compared to t energy found from the light curve and the kinetic energies of the shell. The extent of the ionized region of the shell can be comput knowing the temperature and radius of the exciting star. This is done and compared with the extent obtained in a different manner a previous analysis (Pottasch, 1959). Finally, the composition of the shell is discussed. For five novae the amounts of hydrogen, helium, oxygen, nitrogen, sulphur, calcium, and neon are determi The abundance of the last five elements appears to be greater, by factor of about 5, than the generally accepted cosmic abundance.

52

14453 THE DISTANCE AND ABSORBING POWER OF A DA NEBULA. J.Warzée.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 11, 1063-77 (195

In French.

A graphical method is described, based on the differential Wolf diagram but applicable to those cases where it is too incom to allow direct evaluations of the distance and absorbing power to made. Tables from which the graphs can be constructed are calculated on the basis of Seeliger's law of stellar density distri tions and Van Rhijn's luminosity distribution function. The meth is not applicable to very close nebulae with large radial dimensio A numerical example of its use is given. G.A.Chis

52

14454 THE ESCAPE OF STARS FROM AN ISOLATED CLUSTER. M.Hénon.

Ann. Astrophys., Vol. 23, No. 4, 668-77 (1960). In French.

It is shown that the escape of a star from an isolated cluster

occur only as a result of a close encounter, which causes an
pt increase in energy. The rate of escape was recalculated;
result found was about 100 times smaller than the classical
e. Escape is negligible in globular clusters, and insufficient
ause the disappearance of galactic clusters. However these
lts do not take into account the galactic field.

523.85

14455 THE NUMERICAL INTEGRATION OF n-BODY PROBLEM FOR STELLAR CLUSTERS. I. S.von Hoerner.

Astrophys., Vol. 50, No. 3, 184-214 (1960). In German.

A method is proposed to approach the theory of stellar dynamics
integrating the equations of motion of a random cluster with few
rs. The variable time-step is always governed by the closest pair
stars, and a special definition of the relaxation time is given. The
uracy of the calculation is adjusted to keep the relative energy
or smaller than 5×10^{-4} per relaxation time. A satisfactory degree
reliability of the results is reached by taking the average over a
nber of examples and of relaxation times. Only the first phase
development has been calculated. The relaxation time for
4, 8, 12, 16 agrees very closely with Chandrasekhar's formula.
r n = 8, 12, 16, after 2 to 3 relaxation times, an internal structure
approached which shows no appreciable change within the next
relaxation times. The only exception is the density at great
tance, which increases steadily due to stars escaping from the
tre. This might be used for an estimate of cluster ages. The
sity distribution of the inner region agrees with an isothermal
ytrope, but deviations of 25% could be real. The velocity distri-
ion is Maxwellian within 17%, but shows a remarkable excess of
her velocities. These are due to close pairs and have nothing to
with escaping stars. Therefore, the velocity distribution does
seem to give an adequate description and should be replaced by
distribution of the total energies (kinetic plus potential) of the
rs. Compared with theory, the production of stars with higher
ergies is too small by a factor of about 5. A rediscussion of the
ory is suggested.

523.87

14456 THE INTERPRETATION OF CONTINUOUS STELLAR SPECTRA. REMARKS ON THE SIMILARLY TITLED MMUNICATION BY A.UNSÖLD. H.Kienle.

Astrophys., Vol. 50, No. 1, 73-4 (1960). In German.

See Abstr. 4904 of 1960. Maintains that there is a true intensity
riation in the continuum at about $1/\lambda = 2.15$.

523.87

14457 REPLY TO THE PREVIOUS REMARKS OF H.KIENLE "THE INTERPRETATION OF CONTINUOUS STELLAR ECTRA". A.Unsöld.

Astrophys., Vol. 50, No. 1, 75-8 (1960). In German.

It is pointed out that measurement errors disallow Kienle's
sertion (see preceding abstract).

523.87

14458 EARLY-TYPE STARS USED AS STANDARDS IN PHOTO-ELECTRIC Hβ PHOTOMETRY. D.L.Crawford.

strophys. J., Vol. 132, No. 1, 66-7 (July, 1960).

Narrow-band photoelectric photometry of the Hβ absorption line
s been made on 33 stars used as standards in current work on
-type stars. The observations were made with several different
lescopes, photometers, and filter sets, but all have been transferred
the same system. It is intended that these stars will define this
stem for the early-type stars.

523.87

14459 THE SPECTRUM OF RR TELESCOPII BETWEEN MAY 1949 AND AUGUST 1950.

.R.Pottasch and C.M.Varsavsky.

nn. Astrophys., Vol. 23, No. 4, 516-27 (1960). In French.

The observations of the slow nova RR Telescopii just before,
uring, and just after its light maximum in 1949 are presented in
etail.

523.87

14460 NEON ABSORPTION LINES IN A NOVA SPECTRUM. D.B.McLaughlin.

strophys.J., Vol. 131, No. 3, 739-40 (May, 1960).

A group of lines around 6000 A in the spectrum of Nova Aquilae
945 have been indentified as due to Ne I. A table is given.

P.A.Young

523.87

14461 LINE-BLANKETING EFFECTS ON A—G DWARFS. W.G.Melbourne.

Astrophys. J., Vol. 132, No. 1, 101-29 (July, 1960).

The subject of line blanketing and its effect on the continuous radiation and measured colours of dwarf and subdwarf stars was reviewed. Observed energy distributions corrected for blanketing were compared with theoretical flux distributions derived from model atmospheres. Reasonable agreement was obtained, and the comparisons serve to establish a set of effective temperatures for these stars. The U, B, V colours of these stars were computed from the observed energy distributions, and the results were compared with the observed colours. The effects of line blanketing with and without the hydrogen lines on the U, B, V colours were quantitatively assessed. Line-free U, B, V and colour-magnitude main-sequence relationships were subsequently obtained. A three-dimensional (U—B) – (B—V) effective temperature relationship was established.

523.87

14462 CLASSIFICATION OF SPECTRA FROM OBJECTIVE-PRISM PLATES WHICH INCLUDE THE ULTRAVIOLET REGION. J.J.Nassau and C.B.Stephenson.

Astrophys. J., Vol. 132, No. 1, 130-5 (July, 1960).

The purpose of this investigation is a first step in the survey of stars of high luminosity in the northern sky, a project jointly undertaken by the Hamburg and Warner and Swasey Observatories. Slettebak and Stock have published criteria derived from objective-prism spectra utilizing the ultraviolet region and particularly the Balmer discontinuity. A similar study has been undertaken with a newly acquired objective prism which records spectra to about 3200 A. In the collection of standard MK types, a number of peculiar stars have been included with the hope of augmenting their classification criteria from the ultraviolet region. Results for the OB stars and the other highly luminous classes are, in general, in good agreement with the previous investigation. Specifically, luminosity classes Ia, Ib, and II may be recognized between B6 and G0, and class III is recognizable from B7 to A5 and again at G0. The results for peculiar stars are as follows: The ultraviolet proves to be particularly useful for the identification of the common types of white dwarf and at least some A-type subdwarfs and is helpful in certain types of variable, as, for example, R CBr, and SS Cygni at minimum light. However, a number of peculiar stars appear normal at the dispersion used, even far into the ultraviolet. From the limited number of standards available, F-type subdwarfs fail detection. RR Lyrae appears as a normal A type of luminosity Ib—II. The Milky Way survey includes plates in the region between 5900 and 6900 A in order to eliminate early-type objects which simulate high-luminosity OB stars in consequence of Balmer emission. These plates prove useful in the detection of planetary nebulae and stars showing emission lines, also early M and S stars with greater certainty than the early infrared surveys. Carbon stars with strong cyanogen bands are also identifiable.

523.87

14463 OBSERVATIONAL LIMITATIONS TO MASS LOSS BY NORMAL LATE-TYPE GIANTS. O.C.Wilson.

Astrophys. J., Vol. 132, No. 1, 136-45 (July, 1960).

Spectroscopic observations of H and K lines of Ca II in several hundred late-type stars are discussed, and it is shown that the measured displacements provide no evidence for ejection of matter from normal giants earlier than M0. Also, some simple calculations show that the absence of true circumstellar lines from the spectra of these objects implies a rate of mass loss less than 10^{-10} ⊙ per year. Hence if these stars must lose a substantial portion of their masses before becoming white dwarfs there appear to be only two alternatives: either they all must eventually evolve to M-type stars and remain such long enough to eject the necessary amount of matter; or they are ejecting matter at present but by some unknown mechanism which permits the process to escape observation. There is also a brief discussion of mass loss in general and with reference to α Herculis in particular.

523.877

14464 THE EVOLUTION OF MASSIVE STARS. I. S.Sakashita, Y.Ôno and C.Hayashi.

Progr. theor. Phys., Vol. 21, No. 2, 315-23 (Feb., 1959).

The evolution of stars with mass 15.6 times the solar mass is considered in their early stage. The model star consists of three regions: a convective core consuming hydrogen, a radiative envelope, and an intermediate zone of continuously varying composition.

Radiation pressure is taken into account throughout the three regions. The hydrogen content in the core ranges from 90 - 6.3% by weight. It is found that the convective core retreats as its hydrogen content decreases, setting up the intermediate zone of continuously varying composition and a thin convective unstable region between the radiative envelope and the intermediate zone. The evolutionary track in the H-R diagram is compared with the stars of the h + χ Persei clusters.

523.877 : 539.17

14465 A NOTE ON THE NUCLEAR REACTIONS IN STARS.

S.Nakamura, T.Ohmura and M.Taketani.

Progr. theor. Phys., Vol. 21, No. 1, 18-28 (Jan. 19, 1959).

Building up of the elements in stars by helium capture, neutron capture and proton capture is considered. A possible model for the formation of the iron peak is presented. A new neutron source is suggested.

523.877 : 539.17

14466 STELLAR SYNTHESES OF THE α-PARTICLE NUCLEI HEAVIER THAN Ne^{20}.

C.Hayashi, M.Nishida, N.Ohyama and H.Tsuda.

Progr. theor. Phys., Vol. 20, No. 1, 110-12 (July, 1958),

Various possibilities are discussed of explaining the observed abundances in stellar interiors of the α-particle nuclei Mg^{24}, Si^{28}, S^{32} and A^{36} in terms of the nuclear reactions $Ne^{20}(\gamma,\alpha)O^{16}$ and successive (α,γ) processes together with heavy-ion reactions such as $C^{12}(C^{12},\alpha)Ne^{20}$. The conditions of temperature and density required for such an explanation, and the likelihood of their occurrence in several types of stellar process, are considered.

R.E.Meads

523.877

14467 CONVECTION IN AN ATMOSPHERE WITH A DEPTH-DEPENDENT TEMPERATURE GRADIENT AND A LARGE DENSITY VARIATION. K.H.Böhm and E.Richter.

Z. Astrophys., Vol. 50, No. 2, 79-95 (1960). In German.

Thermal convection in three-layer model atmospheres of the following kind is investigated. A convection zone consists of a narrow layer, with a large excess of the actual temperature gradient over the adiabatic one, superposed on a deep layer with a much smaller excess temperature gradient. On the top of the whole convection zone there is a stable zone of small thickness. A large density variation between the top and the bottom of the convection zone is assumed. The relation between the horizontal wave-number of a disturbance and the degree of instability is derived for four different models of this type and leads to the following conclusions. (1) The rapid increase of the degree of instability with increasing wave-number as found by Skumanich (1955) depends critically on the assumption that the unstable zone extends exactly up to the surface of the star. Even if the convection zone is superposed only by a narrow stable layer the increase of instability with wave number is much slower. (2) Modes of convection with vertical mass flow confined essentially to the narrow layer of high excess temperature gradient increase much more rapidly with time than modes with a large exchange of matter between both parts of the convection zone. (3) For a model with constant polytrope exponent within the unstable zone, convection modes of large horizontal wave number also show a larger flow of mass in the upper regions of the zone than in the lower part. But the effect is much less pronounced than in the case of a two-layer model of the unstable zone. The assumption of the characteristic scale of the mass flow being proportional to the scale height (for pressure, the density or the temperature) leads to inconsistencies.

523.877 : 539.11

THE UNIVERSAL FERMI INTERACTION AND ASTROPHYSICS. See Abstr. 12838

525

14468 CONTROLLED EXPERIMENTS IN CELESTIAL MECHANICS. G.M.Clemence.

Astron. J., Vol. 65, No. 5, 272-3 (June, 1960).

Experiments are described for measuring a possible dependence of the earth's gravitational field on its orbital velocity, a secular change in the constant of gravitation, the constants of the orbit of the earth, the mass of the moon, and the mechanical ellipticity of the moon.

525 : 551.5 : 621.39

N.A.S.A. SPACE SCIENCES PROGRAMME. See Abstr. 14183

525 :

VEHICLES AND PLANS FOR ASTRONOMICAL OBSERVATI ABOVE EARTH'S ATMOSPHERE. See Abstr. 14371

14469 RECENT EXPERIMENTS FROM ROCKETS AND SATELLITES. H.Friedman.

Astron. J., Vol. 65, No. 5, 264-71 (June, 1960).

During 1959, rocket experiments succeeded in advancing several areas of ultraviolet and X-ray astronomy. The solar dis was photographed in Lyman-α with a resolution of better than on minute of arc. Spectrograms were obtained down to wavelengths below the He I and He II resonance lines. Solar X-ray emission incident with visible flares was mapped from 60 A down to 0.2 A. For the first time a small optical telescope was used for the stu of ultraviolet emissions in the night sky. It demonstrated the fea ibility of ultraviolet colour mapping of the stars and has given so new ideas of the nature of the ultraviolet nebulosities surroundin the early stars.

14470 THE MOTION OF AN ARTIFICIAL SATELLITE IN T VICINITY OF THE CRITICAL INCLINATION.

Gen-ichiro Hori.

Astron. J., Vol. 65, No. 5, 291-300 (June, 1960).

The motion of an artificial satellite near the critical inclinat is studied by the method of canonical transformation. The soluti valid to the order of the square root of the coefficient of the seco harmonic of the earth's potential, gives three different types of motion of the perigee: circulation, libration, and the transition t

14471 AN EXTRAPOLATION FORMULA FOR STEPPING T CALCULATION OF THE ORBIT OF AN ARTIFICIAL SATELLITE SEVERAL REVOLUTIONS AHEAD AT A TIME.

D.Mace and L.H.Thomas.

Astron. J., Vol. 65, No. 5, 300-3 (June, 1960).

A method of solving the equations of motion of an artificial satellite has been developed in which not every successive revolu is computed; several revolutions are extrapolated ahead from ea computed revolution. If it is allowable to extrapolate five revolutions, for example, the work of computing is reduced almost by a factor of five. This method was applied to a typical satellite orbi computation and was found to provide predictable accuracy.

14472 THE INFLUENCE OF THE SOLAR RADIATION PRESSURE ON THE MOTION OF AN ARTIFICIAL SATELLITE. P.Musen.

J. geophys. Res., Vol. 65, No. 5, 1391-6 (May, 1960).

Reports an investigation of the effect of solar radiation press on the motion of an artificial satellite. The theory has been appli to the orbit of the Vanguard I satellite, and is found to produce significant perturbations in the perigee height of that satellite. In the case of a satellite with a large ratio of area to mass the majo terms introduced by solar radiation pressure can reduce the peri distance at the rate of 1 to 2 km per day, so that the lifetime of th satellite will become considerably shorter than it would be withou this effect.

5

14473 INDUCTION DRAG ON A LARGE NEGATIVELY CHAR SATELLITE MOVING IN A MAGNETIC-FIELD-FREE IONOSPHERE. P.J.Wyatt.

J. geophys. Res., Vol. 65, No. 6, 1673-8 (June, 1960).

An induction drag, experienced by a charged satellite during traversal of the ionosphere, has been theoretically postulated by several authors. Previous "exact" treatments of the problem are inapplicable to large systems, and the semiempirical approach of Jastrow and Pearse may yield somewhat questionable results. (Abstr. 4688 of 1958). The present description initially considers the satellite as a completely permeable spherical shell of charge, thus avoiding the difficult boundary conditions introduced by the "exact" linearized treatment. The effects of permeability are the shown to be approximately removable by means of an iterative pr cess. A final result, apparently valid to within an order of magnitude, is obtained for the drag force arising solely from electrical effects. Its magnitude is considerably less than that obtained by Jastrow and Pearse.

525

14474 THE FLUCTUATIONS OF THE ACCELERATION OF SATELLITES. H.K.Paetzold.
atmos. terrest. Phys., Vol. 16, No. 3-4, 259-62 (Nov., 1959).

525

14475 SECULAR AND PERIODIC MOTIONS OF THE NODE OF AN ARTIFICIAL EARTH-SATELLITE.
Blitzer; D.G.King-Hele.
ature (London), 186, 874-5, 875 (June 11, 1960).

Letter concerning criticism by King-Hele (Abstr. 11766 of 1959) some papers by the author and collaborator (Abstr. 1036, 5016 of 57), with reply by King-Hele. A.Boksenberg

525

14476 STABILITY OF ROTATING SPACE VEHICLES. H.L.Newkirk, W.R.Haseltine and A.V.Pratt.
roc. Inst. Radio Engrs, Vol. 48, No. 4, 743-50 (April, 1960).

It is shown that at least for some important applications, the trinsic stabilization obtained by rotation of the entire vehicle is dvantageous. Investigations which have been made of natural ethods for damping nutational vibrations of such rotating vehicles re discussed in the following manner. A laboratory simulator is escribed which has been found very useful in testing the various evices suggested for nutation damping. (References to recent nalytical studies of nutation dampers are given). One approach, rigorous attack on a simplified arrangement, is described in ome detail. Also, formulae based on an intuitive approach are erived for the design of both the pendulum and the mercury dam- ers. Finally, an interesting and, it is believed, entirely new basic esign criterion for stable operation of coupled rotating bodies, uch as a space vehicle with pendulum nutation dampers, is demon- trated.

525 : 537.59

14477 RADIATION INFORMATION FROM 1958δ_2. R.P.Basler, R.N.DeWitt and G.C.Reid.
. geophys. Res., Vol. 65, No. 4, 1135-8 (April, 1960).

The telemetered radiation information from the satellite 1958δ_2 Sputnik III) has been analysed for 62 separate passes recorded in ollege, Alaska. The data indicate a dependence of radiation intens- ty on altitude in the range 250 to 500 km. Both the high- and the ow-energy components apparently contribute to the over-all increase f intensity with altitude, but the presence of a continuous afterglow n the scintillating crystal prevented detailed interpretation of the esults.

525 : 551.5

DENSITY OF THE UPPER ATMOSPHERE AND ITS DEPENDENCE N THE SUN, AS REVEALED BY SATELLITE ORBITS. See Abstr. 4201

525 : 551.5

THE DETERMINATION OF THE ELECTRON DISTRIBUTION IN THE UPPER IONOSPHERE FROM SATELLITE DOPPLER OBSERVATIONS. See Abstr. 14261

525 : 551.5

ELECTRON DENSITY MEASUREMENTS IN THE UPPER IONOSPHERE USING THE FARADAY ROTATION OF RADIO SIGNALS FROM ARTIFICIAL SATELLITES. See Abstr. 14262

525 : 551.5 : 621.391.812.63

IONOSPHERIC SCINTILLATIONS OF SATELLITE SIGNALS. See Abstr. 14314

525 : 621.396.96

14478 MEASUREMENT OF THE DOPPLER SHIFT OF RADIO TRANSMISSIONS FROM SATELLITES. G.C.Weiffenbach.
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 750-4 (April, 1960).

Describes a receiving station network that was designed to produce Doppler data for use in a satellite Doppler navigation system.

525 : 621.396.96

14479 APPLICATIONS OF DOPPLER MEASUREMENTS TO PROBLEMS IN RELATIVITY, SPACE PROBE TRACKING, AND GEODESY. R.R.Newton.
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 754-7 (April, 1960).

A discussion is given of the precision with which the Doppler shift in the signal received from a space vehichle can be measured, using existing atomic frequency standards on the ground, and a proposed transponder system on the vehicle. Applications of Doppler methods to measuring the gravitational redshift, to tracking space probes and measuring certain astronomical constants, and to geodesy, making use of the precision of atomic standards, are then presented. The conclusion drawn is that Doppler methods can improve upon existing accuracy in these areas.

529 : 539.18

14480 ACCURATE MEASUREMENT OF TIME. L.Essen.
Proc. K. Ned. Akad. Wetensch., Vol. 63, No. 3, 221-7 (1960). Also in: Phys. Today, Vol 13, No 7, 26-9 (July, 1960).

A simple account of the working principles and uses of caesium atomic clocks.

529 : 621.374.3

14481 TIME ANALYSER USING A CRYSTAL-CONTROLLED TROCHOTRON TUBE. T.Dobrowolski and J.Walker.
J. sci. Instrum., Vol. 37, No. 8, 289-91 (Aug., 1960).

A nine-channel timing system is described in which a crystal oscillator has its output switched by a starting signal and is then used to drive a beam-switching tube (Burroughs, type MO-10R). An accurate sequence of voltage impulses is thus produced and these operate conventional circuits which gate the signals to be timed. The accuracy of the system is discussed briefly.

PHYSICS

GENERAL

53

14482 ROBERT WICHARD POHL: OERSTED MEDALIST FOR 1959. C.J.Overbeck.
Amer. J. Phys., Vol. 28, No. 6, 528-9 (Sept., 1960).

Remarks made by the Chairman of the Committee of Awards for 1959 during the presentation ceremony of the Oersted Medal to Robert Wichard Pohl in recognition of his notable contributions to the teaching of physics.

53

14483 WESLEYAN CONFERENCE ON DEMONSTRATION LECTURES.
Amer. J. Phys., Vol. 28, No. 6, 539-41 (Sept., 1960).

A working conference, sponsored by the American Association of Physics Teachers and supported by the National Science Foundation, was held at Wesleyan University June 22-24, 1959. A list of participants appears in a report by Wissler, published in Physics Today for November, 1959. The Conference committee on Summary and Recommendations, prepared a document which was mailed to all conference members. The present article is their report as revised and condensed by the Editorial Committee.

53

14484 THE MATHEMATICAL FORM OF PHYSICAL LAWS. CHANGES OF UNITS, INVARIANCE OF EQUATIONS, DIMENSIONAL ANALYSIS. R.Saint-Guilhem.
Bull. Soc. Franc. Elect., Vol. 9, 750-8 (Dec., 1959). In French.

For previous work, see Abstr. 11778 of 1959.

53

14485 DEVELOPMENT OF THE CONSEQUENCES OF D.W.SCIAMA AND D.PARK'S THEORY OF INERTIA.
O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 250, No. 12, 2149-51 (March 21, 1960). In French.

The law of inertia is expressed as $F = Im$,,where $I = GM/Lc^2$ is a fundamental constant whose value is unity, M and L being the mass and radius of the universe. The rest-energy of a particle of mass m is expressed as GMm/L and interpreted as the gravitational potential energy of the particle in the total field. Remarks are also made on the interaction between spinning particles and gravitons, and on relations between fundamental micro- and macro-constants.

R.A.Newing

53

14486 POINCARE'S EPISTEMOLOGICAL SUM.

G.Rosen.

Nuovo Cimento, Vol. 16, No. 5, 966-70 (June 1, 1960).

It is the epistemological sum, defined as the union of geometrical and non-geometrical laws, and not space—time geometry alone which is subject to experimental observation. The partition of this sum is considered in relation to relativity and quantum theory, and it is shown how the sum may be repartitioned by a change in the definition of geometrical and non-geometrical observables.

H.Morrison

53

14487 THE RELATIONSHIP BETWEEN THE LAW OF DECAY AND THE FIRST MOMENT OF THE DISTRIBUTION OF ENERGY.

L.A.Khalfin.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 5, 1051-4 (June 11, 1960). In Russian.

The characteristic function, $p_1(t)$, of the energy distribution $\tilde{\omega}(E)$ is defined as

$$p_1(t) \equiv M_1(t)e^{iN_1(t)} = \int_{-\infty}^{+\infty} \tilde{\omega}(E)e^{iEt}dE,$$

and $L(t) = M_1^2(t)$ is the "law of decay". This paper discusses some consequences of the following theorem: "If the energy distribution

$$\tilde{\omega}(E) = \begin{cases} \tilde{\omega}(E) \geq 0, & E \geq 0 \\ 0, & E < 0 \end{cases}$$

has a finite first moment

$$0 < \tilde{\omega}^{(1)} \equiv \int_{-\infty}^{+\infty} E\,\tilde{\omega}(E)dE < \infty,$$

then

$$0 \leq \frac{1}{2\pi}\int_0^\infty \frac{\log L(t)}{t^2}\,dt + \tfrac{1}{2}\tilde{\omega}^{(1)} = \sum_k \frac{\mathrm{Im}(t_k)}{|t_k|^2},$$

where $\sum_k$ denotes summation over all (isolated) zeroes, t_k, of $p_1(t)$ in the half-plane $\mathrm{Im}(t_k) > 0$".

N.L.Johnson

GRAVITATION . RELATIVITY

530.12

14488 ON THE HAMILTONIAN FORMALISM IN SPACE-TIME.

J.Kulhanek.

Nuovo Cimento, Vol. 16, No. 6, 1092-7 (June 16, 1960).

The relativistic mechanics of the material particle in arbitrary coordinates is treated, restricted to the symmetrical metric field. The Hamiltonian function H and the parameter s of the path in four-space are considered as the fifth pair of the canonical conjugate variables. The connection of this Hamiltonian formalism to the three-dimensional Lagrange formalism is investigated and applied to two special cases.

530.12

14489 THE GRAVITON IN THE FUNCTIONAL THEORY OF PARTICLES.

J.L.Destouches.

J. Phys. Radium, Vol. 19, No. 2, 135-9 (Feb., 1958). In French.

Fundamental equations for the particle of maximum spin 2 (graviton). Various forms and explicit forms of these equations are given, together with physical fields of a particle of maximum spin 2 and their equations. These equations have been classified into subsystems.

530.12

14490 PROPERTIES OF EQUATIONS OF THE GRAVITON IN FUNCTIONAL THEORY.

J.L.Destouches.

J. Phys. Radium, Vol. 19, No. 4, 475-9 (April, 1958). In French.

A study of some effects of the field equations associated with a particle of maximum spin 2 (graviton): importance of the systems (S_2), (S_1), (S'_1), (S''_1), (S'_0), (S''_0). Forms of the propagation equations for various fields associated with a particle are given.

53

14491 GRAVITATIONAL WAVES IN GENERAL RELATIVIT

H.Bondi.

Nature (London), Vol. 186, 535 (May 14, 1960).

A report of some results obtained for the emission from a finite isolated axially symmetric system. Various classes of motions are considered, and the source loses mass in general. non-localizable nature of gravitational energy is emphasized.

R.A.Ne

53

14492 RELATIVITY AND QUANTUM THEORY.

B.Kursunoğlu.

Nuovo Cimento, Vol. 15, No. 5, 729-56 (March 1, 1960).

It is shown that Einstein's generalized theory of gravitation modified by the author contains integral and half integral spin fie A constant of the dimension of a length plays a basic role in disti guishing between boson and fermion type fields.

530.12 : 53

14493 NEUTRINO AND GRAVITY.

S.Hayakawa.

Progr. theor. Phys., Vol. 21, No. 2, 324-6 (Feb., 1959).

Since the neutrino is completely polarized along its travellin direction, a β-decay results in the loss of angular momentum fr the universe. As a result of its recoil, the universe begins to r tate, thus violating the mirror symmetry of space. Although the average rotational motion vanishes due to random β-decays, the mean square angular velocity remains finite. This causes the centrifugal acceleration which, according to the equivalence principle, should be equated to the gravitational acceleration due to t loss of neutrino energy. This could take a part in the origin of gravity; the value of the gravitation constant calculated by the a idea is not unreasonable.

53

14494 ON THE TESTS OF GRAVITATIONAL THEORIES IN TERMS OF AN ARTIFICIAL SATELLITE.

H.Nariai and Y.Ueno.

Progr. theor. Phys., Vol. 20, No. 5, 703-14 (Nov., 1958).

It is examined whether or not Singer's test (Abstr. 1042 of 1 and others, if any, would be useful to discriminate between gener relativity and other theories of gravitation. Emphasis is laid up whether curvedness of a space-time could be detectable or not by means of these tests.

53

14495 THE POSSIBILITY OF MEASURING THE GRAVITATIONAL DISPLACEMENT OF FREQUENCY IN THE FIELD OF GRAVITATION OF THE SUN.

B.D.Osipov.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 657-8 (Feb., 1960). In Rus

The method requires a highly stable generator in an artificia satellite and another on the moon. The maximum change of frequency would be about 5 × 10^{-11}.

G.A.Chisn

530.

14496 THE RELATIVISTIC KINETIC EQUATION AND THE EQUILIBRIUM STATE OF A GAS IN A STATIC SPHERICALLY-SYMMETRIC GRAVITATIONAL FIELD.

N.A.Chernikov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 333-6 (July 11, 1960). In Russian.

The kinetic equation of a particle in such a gravitational field is derived; the derivation is also valid for particles with zero res mass. The equation is then solved for the equilibrium state of a gas in this field.

J.K.Skwirzyns

530.

14497 A CLASS OF TRANSFORMATIONS IN SPECIAL RELATIVITY.

J.Crampin, W.H.McCrea and D.McNall

Proc. Roy. Soc. A, Vol. 252, 156-76 (Sept. 8, 1959).

Born and Biem [Proceedings of the Royal Academy of Scienc Amsterdam B, Vol. 61, 110 (1958)] have formulated a transformati from the coordinates used by an observer A at rest in an inertial frame the coordinates used by an observer B who has any given rectilinear motion relative to A, and who assigns coordinates as nearly as he can in the same way as A. The existence and properties of this transformation are discussed. Particular attention is devote to an example proposed by Born and Biem in which B's world-line in A's coordinate system is part of a hyperbola meeting A's world-line in two events. The transformation in the example is here ressed in terms of elliptic integrals. Curves are drawn for a erical case to show how A and B each plots the motion of the er and to show the Doppler effect observed by each when the other nsmits radiation of given frequency. The example usually quoted onnection with the clock paradox is discussed as a limiting case he preceding one and it is shown that certain features are there- clarified. The well-known case of uniformly accelerated motion special relativity is also a particular case of Born and Biem's mple; its properties are discussed and illustrated by diagrams. ally, a short discussion of the clock paradox, arising out of Born Biem's treatment, is given.

530.12

14498 RELATIVISTIC OBSERVATIONS AND THE CLOCK PROBLEM. J.Terrell.

ovo Cimento, Vol. 16, No. 3, 457-68 (May 1, 1960).

Relativistic observational data are discussed, with the purpose clarifying some aspects of the clock problem, usually called the lock paradox" or "twin paradox". Einstein's position, that an ideal ock which moves in a closed curve with respect to an unaccelerated ock will indicate the passage of less time, is supported. It is inted out that the sets of observational data of two observers who ke the place of the clocks in the above situation will not be at all milar. Furthermore, the data of the accelerated observer, obined by means of single Doppler shift and visual observational ethods, will be highly implausible and inconsistent with data obined by radar and double Doppler shift methods. Thus the celerated observer will be under no temptation to consider himself a situation equivalent with that of the unaccelerated observer, and ould not be surprised to discover upon returning that he has aged ss than the other observer. It is pointed out that the accelerated server will see striking effects due to relativistic aberration which ll not be seen by the other observer, but that neither observer will able to see or photograph the Lorentz contraction. Only the pecial theory of relativity is necessary in these calculations, since genuine gravitational fields, produced by massive bodies, are volved.

530.12

14499 THE CLOCK PARADOX IN SO-CALLED RELATIVITY THEORY. A.D.Fokker.

hysica, Vol. 24, No. 12, 1119-20 (Dec., 1958).

In common with Fock, the author objects to the application of e term "relativity" to the theory of the space-time continuum. ttention is called to Robb's axiomatic development of space-time eometry, and it is noted that the clock paradox is implied in one the theorems in this geometry. R.A.Newing

530.12

14500 A SPINOR APPROACH TO GENERAL RELATIVITY. R.Penrose.

nn. Phys. (New York), Vol. 10, No. 2, 171-201 (June, 1960).

A calculus for general relativity is developed in which the basic ole of tensors is taken over by spinors. The Riemann—Christoffel ensor is written in a spinor form according to a scheme of Witten. t is shown that the curvature of empty space can be uniquely characerized by a totally symmetric four—index spinor which satisfies a irst order equation formally identical with one for a zero rest-mass article of spin two. However, the derivatives used here are coariant, so that on iteration, instead of the usual wave equation, a onlinear "source" term appears. The case when a source-free lectromagnetic field is present is also considered. The "gravitatonal density" tensor of Robinson and Bel is obtained in a natural vay as a striking analogy with the spinor expression for the Maxwell tress tensor in the electromagnetic case. It is shown that the curature tensor determines four gravitational principal null directions ssociated with flow of "gravitational density", which supplement he two electromagnetic null directions of Synge. The invariants and Petrov type of the curvature tensor are analysed in terms of these, nd a natural classifcation of curvature tensors is given. An essenially coordinate-free method is outlined, by which any analytic olution of Einstein's field equations may, in principle, be found. As n elementary example the gravitational and gravitational-electroagnetic plane wave solutions are obtained.

530.12

14501 ON THE QUASI-STATIC APPROXIMATION IN GENERAL RELATIVITY. R.P.Kerr.

Nuovo Cimento, Vol. 16, No. 1, 26-60 (April 1, 1960).

The three main methods used for solving the quasi-static field quations are discussed and it is shown that certain theorems have to be proved before it can be said that the physical equations of motion follow from the symmetry of the field around the sources. The author proves these results, and in the process shows that there are seven and only seven physical equations of motion for each particle. These correspond to the classical equations of energy, motion and angular momentum. Also, it is shown that the quasi-static field equations may be integrated without expanding any particle parameters, and without introducing a stress-energy tensor.

530.12

14502 MOTION OF MULTIPOLE PARTICLES IN GENERAL RELATIVITY THEORY. W.Tulczyjew.

Acta phys. Polon., Vol. 18, No. 5, 393-409 (1959).

Considers the motion of test bodies described by means of multipole moments of the energy—momentum tensor density. Such a description was first employed by Mathisson (1937). In the present paper the Mathisson method has been considerably simplified as a result of the use of the Dirac δ-function in the energy—momentum tensor. A new invariant definition of the centre of mass is also given. This definition ensures the uniqueness of the equations of motion.

530.12

14503 ON THE CONSERVATION LAWS OF THE GENERAL RELATIVISTIC LAGRANGE FORMALISM. G.Knapecz.

Ann. Phys. (Leipzig), Vol. 6, No. 1-2, 44-54 (1960). In German.

A systematic derivation and classification is given of weak and strong conservation laws associated with a covariant Lagrange density. R.A.Newing

530.12

14504 MECHANICS OF RELATIVISTIC FLUIDS. Y.Fourès-Bruhat.

Cahiers de Phys., Vol. 111, 463-8 (Nov., 1959). In French.

A concise summary of results obtained for the motion of a perfect fluid with special reference to the Cauchy problem. The case of a charged fluid of zero conductivity is analogous to that of a gravitating fluid, but Leray's theorems for hyperbolic systems seem not to be applicable in the case of finite conductivity, and the problem of relativistic causality remains open in this case. R.A.Newing

530.12

14505 THE ARTIFICIAL SATELLITE AND THE RELATIVISTIC RED SHIFT. A.Das.

Progr. theor. Phys., Vol. 18, No. 5, 554-5 (Nov., 1957).

A metric tensor for the field of the rotating earth is used to derive an expression for the time difference between earth and satellite clocks in the case of a satellite moving in a fixed circular orbit. R.A.Newing

530.12

14506 ON WAVE SOLUTION OF FIELD EQUATIONS IN EINSTEIN'S UNIFIED FIELD THEORY. N.N.Ghosh.

Indian J. Phys., Vol. 33, No. 7, 307-15 (July, 1959).

A static non-symmetric tensor field $g_{\mu\nu}$ with 4 symmetric components S_{kk}, S_{mm}, S_{nn}, $S_{\iota\iota}$ (k, m, n, ι = 1, 2, 3, 4) and one anti-symmetric component a_{mn} (the rest being all zeros), involving either the coordinate x_k or the coordinates x_k, x_m is made non-static by changing x_k into $x_k + \epsilon x_\iota$ where ϵ is a constant. On solving the relevant field equations in the "strong" form it is found that such a wave solution is generally spurious, being transformable into corresponding static solution. It is, however, observed that if the field is not spherically symmetric non-trivial solutions in wave form may be constructed.

530.12

14507 GENERAL STATIC SPHERICALLY SYMMETRIC SOLUTION OF THE "WEAKER" EQUATIONS OF EINSTEIN'S UNIFIED THEORY. G.Bandyopadhyay.

Sci. and Culture, Vol. 25, No. 7, 427 (Jan., 1960).

530.12

14508 GAUGE INVARIANCE AND THE LORENTZ PONDERMOTIVE FORCE. L.Motz.

Phys. Rev., Vol. 119, No. 3, 1102-5 (Aug. 1, 1960).

It is shown that if one introduces into the Weyl theory of gauge invariance the two additional conditions that gauge (and therefore length), except for an arbitrary phase factor, be integrable along the path of a particle, and that the change in dimensions of a particle be a minimum, one immediately obtains the Lorentz pondermotive force for a charged particle in an electromagnetic field and the Bohr—Sommerfeld quantum integral.

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

14509 TRANSCENDENTAL EQUATION FOR THE SCHRÖDINGER EQUATION.

J.R.M.Radok.

Math. Comput., Vol. 14, 276-7 (July, 1960).

530.14

14510 ON THE THEOREM OF VON NEUMANN CONCERNING THE ESSENTIAL INDETERMINISM OF QUANTUM MECHANICS.

J.Tharrats.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3786-8 (June 8, 1960). In French.

The problem concerning the impossibility of reducing to zero the dispersions of all observable quantities is examined. The proof given by von Neumann is criticized mainly in that it is made for projections, and these do not represent observable quantities. An alternative proof is given by considering operators which have a discrete spectrum. H.Morrison

530.14

14511 UNITARY TRANSFORMATIONS AND THE ACTION PRINCIPLE.

J.Schwinger.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 6, 883-97 (June, 1960).

Continuation (Abstr. 3449, 8554 of 1960) and completion of an investigation into the foundations for a general theory of quantum dynamics of systems with continuous degrees of freedom. W.A.Hepner

530.14

14512 UNITARY OPERATOR BASES.

J.Schwinger.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 4, 570-9 (April, 1960).

This is a continuation of two previous papers (Abstr. 3449, 8554 of 1960) on the fundamental mathematical structure of quantum mechanics based on the measurement algebra for atomic phenomena where the interactions between the system and the measurement apparatus cannot be indefinitely weakened. W.A.Hepner

530.14

14513 COMMUTATION RELATIONS OF QUANTUM MECHANICS.

J.V.Lepore.

Phys. Rev., Vol. 119, No. 2, 821 (July 15, 1960).

The mathematical and physical meaning of the commutation relations of nonrelativistic quantum mechanics is discussed in terms of the representation of translations, Galilean transformations, and rotations of the coordinate system by unitary transformations acting on the unitary vector space of quantum states.

530.14

14514 THE QUANTIZATION OF THE ENERGY—MOMENTUM TENSOR IN A DIELECTRIC MEDIUM.

R.Dobbertin.

C.R.Acad. Sci. (Paris), Vol. 250, No. 26, 4298-300 (June 27, 1960). In French.

The quantization of the energy—momentum tensor in a moving, perfectly insulating medium, is carried out using a Lagrangian of simplified form. This, together with a general Lorentz condition, leads to the classical field equations. H.Morrison

530.14

14515 THE CONNECTION BETWEEN THE WIGHTMAN FUNCTIONS AND THE RETARDED COMMUTATORS

O.Steinmann.

Helv. phys. Acta., Vol. 33, No. 4, 257-98 (1960).

The connection between Wightman's vacuum expectation values and the retarded functions of Lehmann et al. (Abstr. 901 of 1956) is investigated in the case of the four-point function. Necessary and sufficient conditions for the existence of a Wightman function corresponding to a given $r(x_0,\ldots,x_3)$ are derived. The Fourier transform $\check{r}(p_1,p_2,p_3)$ of $r(x_0-x_1,\ldots,x_0-x_3)$ is a boundary value of an analytic function $\tilde{r}(k_1,k_2,k_3)$, regular in a domain $\mathfrak{H}$ which is defined in the present text. Certain boundary values of this function other than $\check{r}(p_j)$ satisfy a linear identity. This identity enlarges the domain of regularity of $\tilde{r}$ still further. The Fourier transform $\tilde{\tau}(p_1,p_2,p_3)$ of the time-ordered product $\tau(x_0-x_1,\ldots) = \langle TA(x_0)\ldots A(x_3)\rangle_0$ is shown to be everywhere a boundary value of the same analytic function $\tilde{r}(k_j)$. For the n-point case it is shown that $W(x_0,\ldots,x_{n-1})$ if it exists at all, is uniquely determined by $r(x_0,\ldots,x_{n-1})$ up to terms of a very special kind.

530.

14516 QUANTUM THEORY IN PSEUDO-HILBERT SPACE.

G.Konisi and T.Ogimoto.

Progr. theor. Phys., Vol. 20, No. 6, 868-75 (Dec., 1958).

A method for treating the Hilbert space with an indefinite metric operator is given. Any transformation of state vectors and operators appearing in physics is generated by a "pseudo-unitary operator". For such transformations two kinds of transformation properties, "covariant" and "contravariant", are considered, just as in the case of the Lorentz transformations in the Minkowski space. It is shown that the difficulty of the Lorentz non-invariance of Gupta's theory in quantum electrodynamics is due to the ignorance of such transformation properties. By applying this method to the electromagnetic field, a covariant quantum electrodynamics is formulated.

530.1

14517 ON POSSIBLE EXPERIMENTAL TESTS FOR THE PARADOX OF EINSTEIN, PODOLSKY AND ROSEN.

A.Peres and P.Singer.

Nuovo Cimento, Vol. 15, No. 6, 907-15 (March 16, 1960).

In order to avoid the well-known paradox of Einstein, Podolsky and Rosen, some modifications can be introduced in quantum mechanics, along lines pioneered by Furry. These modifications obviously have to be tested experimentally. Some time ago, Bohm and Aharonov claimed that an experiment of Wu and Shaknov (on the correlation of polarizations of annihilation photons) can be considered as an empirical proof against the Furry hypothesis. However, a careful analysis of the properties of photons shows that they are not suitable to formulate the paradox of Einstein, Podolsky and Rosen, so that the argument of Bohm and Aharonov against the Furry hopothesis is not valid. Some other possible experimental tests are proposed.

530.1

14518 UNIQUENESS OF THE ORBITAL ANGULAR MOMENTU OPERATORS.

J.S.Lomont and H.E.Moses.

Nuovo Cimento, Vol. 16, No. 1, 96-103 (April 1, 1960).

In a separable Hilbert space in which the three Cartesian coordinates form a complete set of commuting variables, it is proved that Hermitian operators which satisfy the commutation relations for the angular momentum operators are unique within a unitary transformation.

530.14 : 538.5

14519 DISSIPATION IN QUANTUM MECHANICS. THE HARMONIC OSCILLATOR.

I.R.Senitsky.

Phys. Rev., Vol. 119, No. 2, 670-9 (July 15, 1960).

The need for a quantum-mechanical formalism for systems with dissipation which is applicable to the radiation field of a cavity is discussed. Two methods that have been used in this connection are described. The first, which starts with the classical Newtonian equation of motion for a damped oscillator and applies the conventional formal quantization techniques, leads to an exact solution; but subsequent discussion shows that this method is invalid, the results being unacceptable from a quantum-mechanical viewpoint. Th second method, which considers the interaction of two systems, the lossless oscillator and the loss mechanism, is adopted in the prese article. No special model is used for the loss mechanism, but this mechanism is assumed to have a large number of densely-spaced energy states. The approximations with respect to the loss mechanism that underlie the concept of dissipation are discussed. These approximations are then applied to the analysis, and a differential equation for a coordinate operator of the harmonic oscillator is obtained which has the formal appearance of the Newtonian equation of motion for a driven damped harmonic oscillator, the driving term being an operator referring to the loss mechanism. The presence of the driving term is responsible for the difference between the present theory and that of the first method mentioned above. A solution of the differential equation for the coordinate operator is given explicitly. An examination of the physical significance of the solution shows that the driving term is responsible not only for the thermal fluctuations which are due to the loss mechanism, but also for the proper commutation relationship of the conjugate coordinates of the oscillator and for its zero-point fluctuations. A generalization of the solution to provide for a classical driving force and coupled atomic systems is given. The results are then restated a form that refers to the loss mechanism only through the two rameters by which it is usually described - the dissipation con-ant and the temperature.

530.14

14520 ON THE PHYSICAL INTERPRETATION OF COMPLEX POLES OF THE S-MATRIX. I.

.Beck and H.M.Nussenzveig.

uovo Cimento, Vol. 16, No. 4, 416-49 (May 1, 1960).

To improve the usual treatment of the transient behaviour of ntinuous systems by the "method of complex eigenvalues", it is cessary to take into account the excitation conditions. This is ne by considering initial value problems. Three examples are vestigated: (1) a harmonic oscillator coupled with a vibrating ring; (2) the electromagnetic oscillations of a perfectly conducting herical aerial; (3) the scattering of Schrödinger particles by a rd sphere. In each case, the general solution of the initial-value oblem is related to the "method of complex eigenvalues" by sociating a propagator with each pole of the S-matrix. In this ay, the difficulty of exponential growth, which occurs in the usual eatment, is eliminated, and the dependence of the decay law on e excitation is exhibited. For Schrödinger particles, the spreading wave packets restricts the domain of validity of the exponential cay law. The origin of the "transient modes" which are associated ith the poles of the S-matrix is discussed. It is shown that the erial modes originate from the effect of inertial forces. The limita-ons on the physical interpretation in the case of short-lived modes e emphasized.

530.14 : 517

A TABLE OF HERMITIAN POLYNOMIALS FOR THE CALCU-ATION OF HARMONIC WAVE FUNCTIONS. See Abstr. 14369

530.14 : 517

MODIFICATION OF FEYNMAN'S "INTEGRAL-OVER-ALL-ATHS" METHOD. See Abstr. 14368

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16

14521 SOME RECENT PROGRESS IN STATISTICAL MECHANICS. G.E.Uhlenbeck.

hys. Today, Vol. 13, No. 7, 16-21 (July, 1960).

Survey article. Retiring address of 1959 president of American hysical Society.

530.16

14522 THE ENERGY SPECTRUM OF THE INDEFINITE INTEGRAL OF A STATIONARY RANDOM PROCESS.

.R.Levin.

adiotekhnika, Vol. 15, No. 6, 19-21 (June, 1960). In Russian.

A non-stationary process of the form

$$\eta_T(t) = \int_{-T}^{t}\xi(t)dt,\ t \geq -T,$$

here $\xi(t)$ is a stationary random process and T is a fixed instant, obtained when studying oscillations frequency-modulated by a andom process (noise). Several authors studied the energy spectrum such oscillations by using the theory of stationary random rocesses, in spite of the fact that the theory cannot be validly xtended to the non-stationary case. This article explains how the esults obtained by these previous authors — which are in fact orrect — should be interpreted. D.E.Brown

530.16 : 536.7

14523 THE FOUNDATIONS OF MECHANICS AND THERMODYNAMICS. E.A.Kearsley and M.S.Green.

hys. Today, Vol. 13, No. 7, 22-5 (July, 1960).

Report of a conference held in Washington, Oct., 1959. There ere five sessions under the following headings: The Mechanics Continuous Media; The Statistical Mechanical Theory of Irrever-ible Processes; The Thermodynamics of Deformable Media; The henomenological Approach to Irreversible Thermodynamics; orld Invariant Electrodynamics.

530.16

14524 SIMPLIFICATION OF THE FORMULAE FOR STATISTICAL WEIGHT CALCULATIONS.

Ya.I.Granovskii.

Zh. eksper. teor. Fiz., Vol. 36, No. 4, 1303-4 (April, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 4, 923-4 (Oct., 1959).

It is shown that

$$W_N = \frac{1}{i\pi^2}\left(\frac{-\pi}{2}\frac{\partial}{\partial E_0}\right)^N (E_0^2 - P_0^2)^{2N-2} \int_0^\infty \frac{\beta_1 d\beta_1 \,.....\, \beta_N d\beta_N}{(\beta_1 + \,......\, + \beta_N)^2} \times$$

$$\times \exp\left\{\frac{i}{\beta_1 + \,.......\, + \beta_N} - \frac{i\nu_1^2}{\beta_1} - \,....\, - \frac{i\nu_N^2}{\beta_N}\right\}$$

where $\nu_k^2 = m_k^2/(E_0^2 - P_0^2)$. Approximate solutions can be obtained by expanding $\exp(-i\Sigma\nu_k^2/\beta_k)$ in a truncated power series.

H.Morrison

530.16

14525 RELAXATION OF AN ISOLATED ENSEMBLE OF HARMONIC OSCILLATORS. K.E.Shuler.

J. chem. Phys., Vol. 32, No. 6, 1692-7 (June, 1960).

The collisional relaxation of an isolated ensemble of harmonic oscillators (at constant volume and energy) from initial nonequilibrium distributions is discussed. The "transport equation" for the relaxation process is derived and it is shown that it can be linearized even though the relaxation takes place via binary oscillator collisions. The final, stationary distribution is found to be a Boltzmann one with a temperature uniquely defined by the mean energy of the ensemble. The Boltzmann H function is obtained for this system of relaxing oscillators and it is shown that $dH/dt < 0$ for all t. The time rate of change of the mean-square deviation of the energy during the relaxation process is computed and is shown to be closely related to the time variation of the mean energy in the relaxation of an ensemble of harmonic oscillators in contact with a thermal reservoir.

530.16

14526 THE SPECTRUM OF FLUCTUATIONS IN COMPLEX PHYSICAL SYSTEMS. O.M.Kalinin.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1417-19 (Sept., 1959). In Russian.

Fluctuations are considered due to the superposition of a series of fluctuating processes forming a normal, stationary, Markov process. The approximation of the intensity spectrum of an arbitrary process by a sum of elementary spectra (i.e. relating to the one-dimensional case) is considered. Applications to the theory of semiconductors are noted. G.A.Chisnall

530.16

14527 LINKED CLUSTER EXPANSION APPLICABLE TO NONSPHERICAL SITUATIONS. A.Klein.

Phys. Rev. Letters, Vol. 4, No. 12, 601-2 (June 15, 1960).

It is shown how the proper self-energy operator can be used to give a complete self-consistent procedure for finding the Fermi surface and total energy of a system without spherical symmetry.

J.Goldstone

530.16

14528 ON THE MANY-BODY PSEUDOPOTENTIAL FOR A SYSTEM OF HARD-SPHERES. R.Abe.

Progr. theor. Phys., Vol. 18, No. 3, 324-6 (Sept., 1957).

The pseudopotential method, which was developed to take account of binary collisions, is generalized to take account of multiple collisions between hard-sphere particles. The lowest-order correction to the ground-state energy of a Bose system due to triple collisions is calculated by this method. D.J.Thouless

530.16

14529 CLUSTER EXPANSION OF THE GROUND STATE OF A BOSE PARTICLE SYSTEM. F.Iwamoto.

Progr. theor. Phys., Vol. 19, No. 5, 595-7 (May, 1958).

Jastrow's cluster expansion is used to evaluate the ground state energy of a hard sphere Bose gas. The first term in the low-density expansion is the same as that found by other workers, and the second term is very slightly larger. D.J.Thouless

530.16

14530 CLUSTER INTEGRALS AND THE GROUND STATE OF BOSONS WITH REPULSIVE INTERACTIONS.

H.A.Gersch and V.H.Smith.

Phys. Rev., Vol. 119, No. 3, 886-91 (Aug. 1, 1960).

The properties of a Bose system of particles with repulsive interactions have previously been treated using perturbation theory in the formalism of second quantization. Others have also considered this problem by dealing with the wave-function in configuration space, using the theory of cluster expansions. In these latter papers, variation with respect to a parameter in a trial function for the ground state has been shown to yield a ground-state energy close to the exact asymptotic expressions obtained from perturbation theory. The connection between the two methods is not immediately obvious from these cluster expansion treatments. It is shown here that, as one might expect, the cluster integral method can be handled so that it is completely equivalent to the pair approximation in perturbation theory.

530.16 : 536.48

14531 EQUATION OF STATE OF A BOSE–EINSTEIN SYSTEM OF PARTICLES WITH ATTRACTIVE INTERACTIONS.

K.Huang.

Phys. Rev., Vol. 119, No. 4, 1129-43 (Aug. 15, 1960).

The equation of state in the grand canonical ensemble is calculated for a system of Bose–Einstein particles with hard-sphere repulsive interactions and weak long-range attractions. The energy levels used in this calculation are modified forms of those derived earlier (Abstr. 49 of 1960). The calculation is carried out in the limit of no interactions, and attention is focused on the thermodynamic phases of the system. It is shown that the gross features of the equation of state of He^4 are reproduced. There are the phases: gas, liquid I, and liquid II. The phase transition between gas and the two liquids are first-order transitions. The transition terminates in a critical point. The transition between liquid I and liquid II is the Bose–Eistein condensation. Liquid II has a negative coeficient of thermal expansion. Across the transition between liquids I and II the specific heat is discontinuous in value. In the limit of no interactions, the critical point recedes towards zero temperature, zero pressure, and infinite volume.

530.16

14532 GROUND STATE ENERGY OF BOSE SYSTEM WITH LENNARD-JONES POTENTIAL. R.Abe.

Prog. theor. Phys., Vol. 19, No. 3, 350-1 (March, 1958).

A preliminary note of an attempt to apply perturbation theory to cases where the potential function cannot be expanded as a Fourier series. It is claimed that sensible physical results, agreeing with known results for the hard-sphere potential, can be obtained by "retaining the finite terms" in the Fourier series. Only an outline of the transformations used is given. H.N.V.Temperley

530.16 : 539.11

14533 THE WIGNER DISTRIBUTION FUNCTION FOR SYSTEMS OF BOSON OR FERMIONS.

K.Schram and B.R.A.Nijboer.

Physica, Vol. 25, No. 8, 733-41 (Aug., 1959).

An expression for the Wigner distribution function valid for systems of bosons or fermions is obtained by making use of correspondence relations between classical quantities and quantum mechanical operators first given by Groenewold (Abstr. 202 of 1947). A general and straightforward derivation of the equation of motion for the Wigner distribution function is presented. The equation governing the temperature dependence of the Wigner distribution function in the case of a canonical ensemble can be derived in a completely analogous way.

530.16

14534 ON THE METHOD OF "AUXILIARY VARIABLES". K.Hiroike.

Progr. theor. Phys., Vol. 21, No. 2, 327-42 (Feb., 1959).

The method of "auxiliary variables" (collective corrdinates) used for a boson system by Bogolyubov and Zubarev (Abstr. 5898 of 1955) is formulated in a somewhat different manner. Improvements are made in two points; (a) the Hamiltonian is given in an Hermitian form and (b) the number of the auxiliary variables can be limited, if necessary. The ground-state energy and the excitation energy spectrum of the spinless bosons are calculated taking account of phonon–phonon interactions. The expression for the ground-state energy is shown to be equivalent to the one derived by Bogolyubov and Zubarev.

530.16

14535 CORRECTION TO THE DEBYE–HÜCKEL THEORY. D.L.Bowers and E.E.Salpeter.

Phys. Rev., Vol. 119, No. 4, 1180-7 (Aug. 15, 1960).

For previous work, see Abstr. 1098 of 1959. The problem of a gas of particles all of the same charge, imbedded in a neutralizing medium of uniformly distributed charge of the opposite sign, is considered in terms of classical statistical mechanics. If a dimensionless parameter ϵ, roughly the inverse of the number of particle contained inside a Debye sphere, is small compared to unity the Debye–Hückel theory is a good first approximation. For this case the corrections in the next order in ϵ are derived for the potential of mean force and the interaction energy. It is shown how this correction has to be modified for very small particle separation; th expansion in powers of ϵ is not strictly a Taylor expansion and factors such as $\ln \epsilon$ appear in the higher terms. Methods are given for numerical calculation of some auxiliary functions even when the parameter ϵ is not small.

530.16 : 536.4

14536 CANONICAL TRANSFORMATION AND PERTURBATIO EXPANSION IN THE THEORY OF FERMI GAS. G.Fano

Nuovo Cimento, Vol. 15, No. 6, 959-69 (March 16, 1960).

A canonical transformation, identical with that of Bogoljubov an Valatin, is performed; and a perturbation expansion of the ground state energy is made by taking, as the unperturbed Hamiltonian, the term describing free "quasi particles". The perturbation is written in normal form; it follows that the canonical transformation cancel to all orders, diagrams containing lines with the two end points at the same vertex. A simple discussion of the ground state energy is given in the case considered by the theory of Bardeen, Cooper and Schrieffer.

530.16 : 539.2 : 538.

14537 FERROMAGNETISM OF A GAS OF HARD SPHERE FERMIONS WITH SPIN $\frac{1}{2}$.

T.Morita, R.Abe and S.Misawa.

Progr. theor. Phys., Vol. 18, No. 3, 326-7 (Sept., 1957).

It is argued that at zero temperature a gas of hard-sphere fermions should be ferromagnetic at sufficiently high densities, because the exclusion principle keeps particles with the same spin apart. The pseudopotential method is used to estimate the density at which the spins should become aligned. D.J.Thoules

530 1

14538 FERMI SURFACE AND SOME SIMPLE EQUILIBRIUM PROPERTIES OF A SYSTEM OF INTERACTING FERMIONS. J.M.Luttinger.

Phys. Rev., Vol 119, No 4, 1153-63 (Aug. 15, 1960).

It is shown that certain analytical properties of the propagator of many-fermion systems lead rigorously to the existence of sharp discontinuities of the momentum distribution at absolute zero. This discontinuity in the momentum distribution is used to define a Ferm surface for a system of interacting fermions. It is shown that the volume of this surface in momentum space is unaffected by the inte action. The same analytic properties are shown to lead, by direct statistical mechanical arguments, to simple expressions for the low temperature heat capacity, the spin paramagnetism, and the compressibility of the system. These expressions are very analogous t the corresponding expressions for noninteracting particles. Finally it is shown how the whole formalism may be generalized when an external periodic potential is present (band case).

530.1

14539 ON A THEORY OF DISPERSION BY CONTINUOUS MOVEMENTS. C.C.Lin.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 4, 566-70 (April, 1960).

A preliminary paper in which Richardson's law of dispersion is derived by applying the general method of Taylor's theory of diffusion by continuous movements, to dispersion from a point sourc The relationship of this theory to those of Oblukhov and Kolmogoroff is mentioned. It appears that the theory is subject to less restrictiv requirements than Kolmogoroff's. G.A.Chisnall

530.1

14540 PROBLEM OF CALCULATING FREE ENERGY OF A GAS OF SMALL DENSITY. E.E.Tareeva.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 568-71 (May 21, 1960). In Russian.

The method of Bogolyubov and Tyablikov (Abstr. 10621 of 1959) for the use of retarded and accelerated Green functions is utilised here to investigate a Fermi gas with small interaction and density. The second correlation function of the system is obtained and this leads to the determination of free energy and of particle distributio following impulses. J.K.Skwirzynsk

530.16

14541 DIFFUSION IN INHOMOGENEOUS MEDIA.

S.Prager.

. chem. Phys., Vol. 33, No. 1, 122-7 (July, 1960).

Methods are given for the calculation of effective diffusion oefficients for inhomogeneous media in which the actual diffusion oefficient varies from point to point in a random manner. An xact result is obtained in the form of an infinite series involving orrelations between diffusion coefficients at n different points. A procedure for deriving approximate expressions involving only wo-point correlations is also developed, and applied, in particular, o the important special case of diffusion through a porous material.

530.16

14542 ON QUANTUM THEORY OF TRANSPORT PHENOMENA: STEADY DIFFUSION.

S.Nakajima.

Progr. theor. Phys., Vol. 20, No. 6, 948-59 (Dec., 1958).

The quantum theory of steady diffusion is formulated. In seeking for a steady solution of Liouville's equation, the boundary condition is taken into account by requiring that the solution should lead to a given distribution of average density. The distribution is to be determined by a macroscopic law of diffusion and macroscopic boundary condition. The basic equation thus obtained has a form similar to Bloch's kinetic equation and reduces to the latter in the limit of a system of weakly interacting particles. This is shown by generalizing a damping theoretical expansion of Kohn and Luttinger. It is found that Einstein's relation is valid only for the symmetric part of diffusion, and electrical conductivity tensors, in agreement with Kasuya's suggestion (Abstr. 12231 of 1959).

530.16

14543 PRINCIPLE OF CORRESPONDING STATES FOR TRANSPORT PROPERTIES.

E.Helfand and S.A.Rice.

J. chem. Phys., Vol. 32, No. 6, 1642-4 (June, 1960).

The principle of corresponding states can be demonstrated by use of the autocorrelation function expressions for the transport properties and the assumption that the intermolecular potential has the form $u = \epsilon u^*(r/\sigma)$. The result follows from the fact that both the canonical ensemble distribution function and the solution of the mechanical equations of motion may be written in reduced variables. One finds that $\eta^* = \eta\sigma^2/m^{1/2}\epsilon^{1/2}$, $\kappa^* = \kappa k\epsilon^{1/2}/m^{1/2}\sigma^2$, and $D^* = Dm^{1/2}/\epsilon^{1/2}\sigma$ are universal functions of $T^* = Tk/\epsilon$, $P^* = P\sigma^3/\epsilon$, and in the quantum mechanical case $\hbar^* = \hbar/\sigma m^{1/2}\epsilon^{1/2}$.

530.16 : 536.7

14544 ON POPOV'S RELATION BETWEEN THE SYMMETRY OF TRANSPORT COEFFICIENTS AND THERMODYNAMICS.

R.Dévis and F.Gudman [R.O.Davies and F.O.Goodman].

Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1163-4 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 828-9 (April, 1960).

A refutation of Popov's proof of Onsager symmetry (Abstr. 8717 of 1955). A similar refutation has been given by Saitô (Abstr. 6662 of 1958). R.O.Davies

530.16 : 532.7

14545 COMMENT ON A PAPER OF MORI ON TIME-CORRELATION EXPRESSIONS FOR TRANSPORT PROPERTIES.

M.S.Green.

Phys. Rev., Vol. 119, No. 3, 829-30 (Aug. 1, 1960).

An auto-correlation expression given by Mori (Abstr. 3203 of 1959) for the thermal conductivity of a fluid is shown to be only apparently different from an expression previously derived by the author (Abstr. 6307 of 1954).

530.16 : 539.17

14546 THE GREEN FUNCTION FOR THE INTEGRO-DIFFERENTIAL OPERATOR OF THE STATIONARY NEUTRON TRANSPORT THEORY.

G.F.Kohlmayr.

Acta phys. Austriaca, Vol. 13, No. 2-3, 300-14 (1960). In German.

The adjoint transport equation is obtained from the neutron balance of a time reversed transport process. The relation between the Green functions of the transport and adjoint transport equations, and the orthogonality relation between the respective eigenvalue problems are described. A useful bilinear series representation is given for these Green functions. It is shown that the Green functions enable criticality problems to be exactly formulated and serve as a starting point for problems with inhomogeneous boundary conditions. D.H.Lord

530.16 : 533.7

14547 TRANSPORT IN DILUTE GASES AND CHEMICAL FORCES.

R.K.Osborn.

J. chem. Phys., Vol. 32, No. 6, 1817-20 (June, 1960).

It is shown that the theory of transport phenomena in gases may be so formulated that the potentials characterizing the cross-sections, which account for interactions between molecules in the binary collision limit, are the same as those conventionally employed in investigations of molecular structure. Thus it is indicated that at least some of the essential features of chemical forces may be conveniently introduced into the description of such phenomena.

530.16

14548 STATISTICAL MECHANICS OF TRANSPORT IN FLUIDS.

J.A.McLennan, Jr.

Phys. of Fluids, Vol. 3, No. 4, 493-502 (July-Aug., 1960).

Transport processes in fluids are discussed in the framework of ensemble theory. A nonequilibrium ensemble is constructed by explicit consideration of the external forces which bring about the deviation from equilibrium. The resulting ensemble has the form of a product of factors, one characteristic of local equilibrium and other containing a description of the irreversible processes. For states near equilibrium (to which the discussion is restricted) the ensemble depends linearly on the thermodynamic parameters which specify the deviation from equilibrium. Transport relations are obtained which are, in general, nonlocal in space and time; that is the transport coefficients are frequency and wavelength dependent. An approximation procedure is used which amounts to an expansion in powers of the wave number, and in the lowest approximation one obtains the familiar local transport relations.

530.19 : 535.3

14549 INCORPORATION OF ERROR FUNCTION ABSORPTION COEFFICIENT IN TRANSPORT EQUATION.

J.H. Chin and S.W.Churchill.

Quart. appl. Math., Vol. 18, No. 1, 93-6 (April, 1960).

Shows how this well-behaved band-averaged absorption coefficient can be incorporated in any solution of the transport equation describing radiative transfer, in the place of the rapidly-varying monochromatic absorption coefficient. J.Hawgood

530.19

14550 A NEW SOLUTION TO A TRANSFER PROBLEM.

D.Barbier and M.Mayot.

Ann. Astrophys., Vol. 22, No. 5, 426-9 (1959). In French.

A solution, involving an approximate procedure for the computation of integrals, allows the transformation of the integral equation into a functional equation.

530.19

14551 THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. IX. DIFFUSE REFLECTION AND TRANSMISSION IN A FINITE ATMOSPHERE WITH ISOTROPIC SCATTERING IN THE NON-CONSERVATIVE CASE.

S.Ueno.

Ann. Astrophys., Vol. 22, No. 5, 468-83 (1959).

For Pt VIII, see Abstr. 7817 of 1959. Using the probabilistic method, the angular distributions have been obtained of the reflected and the transmitted radiation in a plane-parallel, finite and homogeneous atmosphere with isotropic and coherent scattering in the non-conservative case. The laws of diffuse reflection and transmission are equal to those given by Chandrasekhar. The solutions $X(\mu, \tau_1)$ and $Y(\mu, \tau_1)$ as functions of the optical thickness τ_1 coincide also with those given by Sobolev.

530.19

14552 THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. XI. ON THE SCATTERING AND THE TRANSMISSION FUNCTIONS OF S.CHANDRASEKHAR.

S.Ueno.

Ann. Astrophys., Vol. 22, No. 5, 484-90 (1959).

Starting with the stochastic integro-differential equation for the probability distribution $p\ (\mu;\ \tau_1 - \tau,\ \tau_1)$ in the case of diffuse reflection and transmission, the differential equations are derived for the scattering and the transmission functions of Chandrasekhar as functions of the optical thickness τ_1. The results obtained are equal to those given in the preceding abstract.

GENERAL MECHANICS

531.2

14553 A CLASS OF CURVES BELONGING TO A CONNECTING-ROD SYSTEM. I.I.Artobolevskii.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 82-4 (May 1, 1960). In Russian.

These curves are solutions of the pedal equation of a rod belonging to a plane connecting-rod mechanism, with respect to some joint of this mechanism. The equation of these curves is derived and a geometrical construction is provided to obtain state of the connecting-rod system corresponding to a value of angular variable in the pedal equation. J.K.Skwirzynski

531.25

14554 THE BENDING AND SHORTENING EFFECT OF PURE TORQUE. M.Gregory.

Austral. J. appl. Sci., Vol. 11, No. 2, 209-16 (June, 1960).

The general analysis of the bending and shortening of thin open-section members under pure torque is developed, and experimental work is given in confirmation.

531.25

14555 NON-LINEAR BENDING OF A CANTILEVER UNDER SEVERAL CONCENTRATED LOADS. R.Frisch-Fay.

Austral. J. appl. Sci., Vol. 11, No. 2, 233-43 (June, 1960).

The analysis of beams with "large" deflections rests with the solution of non-linear second-order differential equations. It is shown that it is not always necessary to set up this type of differential equation for the solution of more complex cases, since the analysis can be traced back to the well-known results of the basic case, that is, a vertical strut carrying a vertical concentrated force at the top. The particular problem of the deflection under a number of parallel loads is solved. The principles presented can be extended for the solution of the deflection under any number of loads applied in any direction.

531.25

14556 TWISTING OF NOTCHED RECTANGULARLY-SHAPED BARS. A.Hladík.

Czech. J. Phys., Vol. 10, No. 1, 45-7 (1960). In Russian.

531.25

14557 BENDING [FOR SMALL DEFLECTIONS] OF ISOTROPIC THIN SQUARE PLATES BY CONCENTRATED EDGE COUPLES AND FORCES. R.S.Dhaliwal.

Appl. sci. Res. A, Vol. 9, No. 5, 297-318 (1960).

The complex variable method of Muskhelishvili is applied. The functional equation involved in this method is solved using function theory. The necessary conformal mapping function is found from the Schwatz–Christoffel formula or expansion of elliptic functions. A general solution is given for plates which can be mapped on a unit circle by polynomial type mapping functions. Three particular problems are worked out in detail: approximately square plates subjected, respectively, to two bending couples, to two twisting couples, both applied at the ends of a diagonal, and to four forces applied at the four corners. Numerical results are presented in the form of tables and graphs.

531.25

14558 ELEMENTARY SOLUTION OF SOME PLATE PROBLEMS. V.Vodička.

Z. angew. Math. Phys., Vol. 9a, No. 2, 206-10 (1958).

There are many possibilities of generalizing the well-known direct methods of solving problems on bending of elliptic plates. The case where the right-hand side of the basic differential equation is represented by a polynomial of any degree is treated from the general viewpoint. Elementary results cited in the literature can be obtained as special cases of the more general conception.

531.25

14559 LARGE DEFLECTIONS OF NON-LINEAR ELASTIC RECTANGULAR PLATES. L.Wallin.

Ark. Fys., Vol. 17, Paper 4, 89-95 (1960).

An approximate solution is derived for the membrane deflection of a thin rectangular plate of non-linear elastic material hinged at the edges and carrying a uniformly distributed transverse load per unit area. H.J.H.Starks

531.

14560 THE PROBLEM OF THE ELASTIC PLANE CORNER. P.P.Teodorescu.

C.R. Acad. Sci. (Paris), Vol. 250, No. 21, 3446-8 (May 23, 1960). In French.

An elastic quarter-plane subjected to stresses along its edges has distributions of plane stress and displacement which are expressible in terms of the solutions of certain Fredholm integral equations of the second kind. The solution can be modified to solv the corresponding problem for a corner which is not a right-angle. J.G.Oldro

531.

14561 THERMAL STRESSES IN HOLLOW CYLINDERS OF FINITE LENGTH. C.J.Bellamy.

Austral. J. appl. Sci., Vol. 11, No. 2, 217-32 (June, 1960).

A method of analysis is developed for determining the elastic stresses in a thick-walled hollow cylinder of finite length subjecte to an axially symmetric temperature distribution. The general theorem of stationary strain energy is employed, together with an approximate specification of possible stress distributions. Numer results are presented for the particular case of a cylinder of fixed geometrical proportions with a linear radial temperature distribution and Poisson's ratio equal to zero to approximate to the behaviour of concrete.

531.

14562 THIN ANISOTROPIC ELASTIC SHELLS. I. CIRCULA CYLINDER OF CYLINDRICAL AEOLOTROPY. G.Pa

Bull. Calcutta Math. Soc., Vol. 51, No. 3, 123-31 (Sept., 1959).

The effect of anisotropy on the deformation of a thin circular cylindrical shell is considered when it is bent by lateral loads only The theory adopted is that given by Love. It is found that for a particular material the magnitude of deflection in anisotropy may decreased from that in isotropy by 29%, or more, depending upon the polar angle. The smaller the polar angle, the greater the anis tropic effect.

531.

14563 ON THE DANGER OF INSTANTANEOUS DESTRUCTIO OF CONSTRUCTION ELEMENTS UNDER CYCLIC OVERLOADING. G.V.Uzhik and M.Ya.Gal'perin.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 5, 1046-8 (April 11, 1960). In Russian.

Continuation of previous work of Uzhik (Abstr. 1868 of 1960). Steel beams of rectangular cross-sections were periodically overloaded by applying loads concentrated along central notches until breaking. The load/deformation curves are shown and discussed. J.K.Skwirzyns

531

14564 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 8. DRIVEN LINEAR MECHANICAL OSCILLATOR. R.G.Marcley.

Amer. J. Phys., Vol. 28, No. 6, 534-6 (Sept., 1960).

A simple and robust apparatus for quantitative undergraduate investigations of forced damped harmonic motion is described. A variable frequency sinusoidal driving force is applied to a large mass suspended on a helical spring. The damping applied to the moving system may be adjusted. Phase measurements are easily made.

531

14565 THE SPATIAL MOTIONS OF AN AXIALLY SYMMETR SOLID BODY ABOUT A FIXED POINT, SUBJECT TO COUPLES WHICH VARY SLOWLY WITH TIME. G.E.Kuzmak.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 549-52 (May 21, 1960). In Russian.

The body is subject to a restoring couple which depends on th nutation, θ, and on the "slow" time, τ ($\tau = \epsilon t$, where ϵ is a small parameter and t is the time); and to small damping couples. By using standardized ("etalon") equations, simpler than the original but possessing the same initial characteristics, expressions are found from which θ and the precessional velocity can be evaluated accurate to order ϵ^2, if t lies in the interval from 0 to order ϵ^{-1}. G.A.Chisn

531

14566 ON THE MOTION OF A PROJECTILE IN THE ATMOSPHERE. Vi-Cheng Liu.

Z. angew. Math. Phys., Vol. 8, No. 1, 76-82 (1957).

The equation of rectilinear motion of a projectile which moves n an atmosphere, of which the density decreases exponentially with he altitude, is solved. It is found that the velocity of the projectile can be expressed explicitly in terms of confluent hypergeometric unctions. This theory is applied to treat two specific problems: 1) the flight analysis of a sounding rocket during the free-flight period and (2) the calculation of ambient temperature from the rajectory of a spherical projectile.

MECHANICAL MEASUREMENTS

531.71 : 621.317.39 : 621.396.933.2

14567 INTERNATIONAL SYMPOSIUM ON ELECTRONIC DISTANCE-MEASURING TECHNIQUES.

C.A.Whitten and E.Schmid [Editors].

J. geophys. Res., Vol. 65, No. 2, 385-528 (Feb., 1960).

This symposium was held in Washington, D.C., U.S.A. on May 5-12, 1959. Abstracts of some of the papers are published below. The remaining papers, which were condensed or abstracted because of space limitations or prior publication of part of the material, are as follows: Introductory remarks, A.Marussi (385-8); The Geodimeter system — a short discussion of its principal function and future development, E.Bergstrand (404-9); Use of the Geodimeter by the Coast and Geodetic Survey, P.D.Thomas (410); The model 3 Geodimeter for the extension of control for California Highways, J.D.Carter (411); The Tellurometer system — new applications to geodesy and hydrography, R.D.Smith (418-29); Report of electronic distance measurements in Australia, G.R.L.Rimington (430-5); Tellurometer measurements in the base extension network Munich, R.Sigl (436-40); Results of Tellurometer measurements in 1958, K.Gerke (441-3); Remarks concerning current use of the Tellurometer, G.Coets (444-8); Tellurometer trilateration in Arabia, H.Meier (449-52); Tellurometer observations in topographic mapping, J.L.Speert (453); Geodectic base lines, W.A.Heiskanen (454-6); Measurement of standard base line with the Väisälä light-inference comparator, T.Honkasalo (457-60); Canadian Shoran project, J.E.Ross (461); Hiran instrumental developments, P.W.Jordan (462-6); Evaluation of Hiran networks, S.D.Owen (467-71); Simultaneous adjustment of triangulation and trilateration — an investigation of Tellurometer lengths, L.A.Gale (472-7); Experimental results of field tests of the application of the Lorac phase comparison radio location system to distance measurement, B.W.Koeppel (478-89); Microwave position-fixing system, H.R.Smyth (490-8); Electronic control systems used on hydrographic surveys, G.R.Fish (499-505); Some developments in Loran, W.O.Henry (506-13); The method and use of two-range Decca, G.W.LaCroix and D'A.H.Charles (514-24); Transistorized Raydist as used in geological surveys, C.L.Drake and W.C.Beckmann (525-8).

531.71 : 621.317.39

14568 ATMOSPHERIC LIMITATIONS ON ELECTRONIC DISTANCE-MEASURING EQUIPMENT.

M.C.Thompson, Jr, H.B.J.Janes, and F.E.Freethey.

J. geophys. Res., Vol. 65, No. 2, 389-93 (Feb., 1960).

Measurements of path length over a base line of about 15.5 miles, using a radio link operating on approximately 9400 Mc/s, show that lack of knowledge of atmospheric turbulence is the limiting factor in electronic distance measurements. When corrections are applied for the radio refractive index measured at five points along the path the accuracy appears to be limited to several parts per million.

C.Hazard

531.71 : 621.317.39

14569 PHYSICAL PRINCIPLES OF THE ELECTRO-OPTICAL DETERMINATION OF DISTANCES. A.Karolus.

J. geophys. Res., Vol. 63, No. 2, 394-403 (Feb., 1960).

The principles of distance meters based on the methods of Fizeau and Karolus for the measurement of the velocity of light are discussed. The discussion is concerned primarily with the quantitative evaluation of the systematic errors in the methods of modulating light and of light and phase measurement. It is concluded that detailed study is necessary to develop a meter sufficiently accurately for geodetic applications.

C.Hazard

531.71 : 621.317.39

14570 AN ELECTRO-OPTICAL DEVICE FOR MEASURING DISTANCE. A.Bjerhammar.

J. geophys. Res., Vol. 65, No. 2, 412-17 (Feb., 1960).

A light beam is modulated at 4 Mc/s by passage through a piezoelectric quartz crystal between polarizers. The beam is transmitted over the distance to be measured and returned to a photocell. The output from the latter, together with a signal from the oscillator, is fed into a phase-sensitive superheterodyne circuit. The arrangement is suitable for distance from 50 m to 5 km. At 1 km the standard deviation of a single measurement was found to be ∓11 mm.

G.F.Lothian

531.71

14571 A MERCURY SURFACE HEIGHT INDICATOR. E.R.Harrison.

Austral. J. appl. Sci., Vol. 11, No. 1, 198-9 (March, 1960).

The apparatus consists of a light, pointed metal probe which can be adjusted from above so as to make electrical contact with the mercury level, which was in this case accessible only through a $\frac{3}{8}$ in. diameter hole. Contact is indicated by a simple electronic unit which does not cause any contamination of the probe, but which gives no warning of approaching contact. The mercury level is compared with slip gauges, and a micrometer screw enables readings to be made to 0.0001 in. directly and to 0.000 01 in. by estimation.

N.Corcoran

531.71

14572 AN APPARATUS FOR MEASURING CHANGES IN LENGTH OF IRON AT THE $\gamma - \alpha$ CHANGE-POINT.

B.G.Lazarev, A.I.Sudovtsov and A.P.Smirnov.

Exper. Tech. der Phys., Vol. 8, No. 1, 42-5 (1960). In German.

From the original paper in Fiz. Metallov i Metallovedenie, Vol. 7, No. 1, 122-7 (1959). A vacuum dilatometer is described by which the measurements were made. The vacuum was 10^{-6}-10^{-7} torr and the sensitivity of the apparatus was 0.0005 mm. Induction heating was employed and a Pt–PtRh thermocouple used with very fine leads to cut down heat losses.

J.Thewlis

531.74

14573 NEW METHOD OF TESTING DIVIDED CIRCLES. C.Kühne.

Rev. sci. Instrum., Vol. 31, No. 8, 882-5 (Aug., 1960).

The residual uncertainties of angular measurements due to the circle graduation testing methods presently used are touched upon. A new method is described, and its mathematics elucidated. Theoretically, the method permits one to obtain exactly equidistant angular intervals even if the master circles used have errors in their graduations. The method suggested enables division errors of diameters to be measured directly. Further, it is shown how the measurement procedure may be rendered automatic by suitable technical means which would permit determination of the totality of division errors for all graduated circles without prohibitive cost.

531.75

14574 NOVEL DISPLACEMENT DETECTOR AND ITS APPLICATION IN A RECORDING THERMOBALANCE.

J.C.van der Breggen and H.J.Wouterlood.

J. sci. Instrum., Vol. 37, No. 8, 297-300 (Aug., 1960).

A transducer has been developed to detect changes in position of a balance beam. Its operation is based upon a differential capacitor. Variations in capacitance are made to produce directly a d.c. voltage corresponding in sign to the sense of deflection of the balance beam. The construction of the transducer is described, and its application in automatic apparatus for thermogravimetric analysis is illustrated by results obtained on the dehydration of copper sulphate and the decomposition of quinoline phosphomolybdate. The sensitivity of the instrument can be varied in nine steps to give full-scale deflections from 10 to 5000 mg. An accuracy of about 1.5 mg or 0.75% of full scale was obtained for the 200 mg range.

531.76 : 612.8

WEBER RATIO FOR VISUAL DISCRIMINATION OF VELOCITY

See Abstr. 14333

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.1

14575 ROLLING-SPHERE VISCOMETER FOR STRUCTURED LIQUIDS. G.W.S.Blair and J.C.Oosthuizen.

Brit. J. appl. Phys., Vol. 11, No. 8, 332-4 (Aug., 1960).

In the apparatus described, since the sphere is very small compared with the cylindrical tube containing the sample, fresh channels can be found for quite large numbers of tests. In this way measurements are made of hitherto unsheared material, and this is important in studying thixotropic or otherwise structured systems. The instrument may be used even when inertia effects are considerable since, over a wide range of experimental conditions, a very simple correction of the Oseen type is found to apply. Relative viscosities of glycerine—water mixtures and of fat-free milks determined in the sphere viscometer agree adequately with those from an Ostwald or other capillary viscometer; but the structure of renneted milk, even before rigidity sets in, is damaged by the drastic shearing and, for such systems, the rolling-sphere viscometer gives a more reliable picture of viscosity changes.

532.1

14576

FOAM VISCOMETER.

R.J.French.

J. sci. Instrum., Vol. 37, No. 8, 307-8 (Aug., 1960).

A modified form of a torsional-vane viscometer for measuring the critical shear stress of fire-fighting foams is described. The advantages claimed are: Readings can be taken ten seconds after collection of the foam; the torsion wire is not unduly subject to corrosion; no sliding mechanism is required in the drive system; the electrical gear is above the foam container. R.Schnurmann

532.1

14577

WALL EFFECT IN THE FLOW OF LUBRICATING GREASES IN PLUNGER VISCOMETERS.

A.D.Bramhall and J.F.Hutton.

Brit. J. appl. Phys., Vol. 11, No. 8, 363-71 (Aug., 1960).

In the plunger viscometer, grease is sheared between the surface of a long piston, or plunger, and the inner wall of a coaxial cylinder, the motion of the plunger being along the long axis of the cylinder. For some greases the flow curves depend on the width of the gap between the plunger and the cylinder, whilst for others the flow curves are independent of the gap width. The results are best explained by postulating the existence of layers of softer grease adjacent to the viscometer walls with unmodified grease in between. For a given grease the layer thickness is independent of gap width. An analysis is presented which agrees with experimental results and permits the correction of the results to give a unique flow curve for the unmodified bulk grease. The magnitude of the correction shows a tendency to decrease with increasing roughness of the walls, with increasing viscosity of the base oil and with decreasing size of crystalline soap-fibre aggregates in the grease.

532.1

14578

ON THE VISCOSITY OF SUSPENSIONS.

E.F.Kurgaev.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 392-4 (May 11, 1960). In Russian.

Einstein (Abstr. 743 of 1906) gave the formula $\mu_C/\mu_O = 1 + 2.5C$ for the viscosity μ_C of a suspension of spherical particles at a volumetric concentration C in a medium of viscosity μ_O. This formula was valid up to C = 0.05. An improved formula

$$\mu_C/\mu_O = 1 + 2C(1 - 1.2C^{2/3})^{-2}$$

which is valid up to C = 0.25 is derived and fits the experimental observations well. A.L.Mackay

532.1

14579

VISCOSITY OF LIQUID HYDROGEN SULPHIDE.

J.W.Hennel and K.Krynicki.

Acta phys. Polon., Vol. 18, No. 5, 523-6 (1959).

The viscosity of liquid H_2S under the pressure of its saturated vapour in the temperature region from -11.5 to 50°C was measured. A closed type, pressure-resistant Ostwald viscometer was used.

532.1

14580

VISCOSITY OF MOLTEN NICKEL AND NICKEL—COPPER ALLOYS.

A.A.Vertman and A.M.Samarin.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 572-6 (May 21, 1960). In Russian.

The concentration and temperature dependence of the kinetic viscosity, v, of Ni—Cu alloys was experimentally determined. It was established that $v = k \exp(E/RT)$, where E is the activation energy for viscous flow. No anomalies in the temperature dependence of v of pure Ni, reported by Belashchenko, were observed, but it was found that v of Ni increased with increasing oxygen content. M.H.Sloboda

532.5 : 541.18

14581

AN EXTENSION OF GOODEVE'S IMPULSE THEORY OF VISCOSITY TO PSEUDOPLASTIC SYSTEMS.

T.Gillespie.

J. Colloid Sci., Vol. 15, No. 3, 219-31 (June, 1960).

An attempt has been made to derive a theory of pseudoplasticity which may be used as a guide in combined studies of rheology and flocculation kinetics. Goodeve's impulse theory of viscosity was used as a starting point. The shear stress-shear rate relation obtained is a more general form of Williamson's empirical equation for pseudoplasticity. The behaviour of a given system may be traced in terms of link formation and link rupture rate constants which are related to flocculation and deflocculation rate constants which are susceptible to experimental investigation. Some preliminary data obtained with thickened pseudoplastic latex systems are used to illustrate the application of the theory.

532.

14582

RATE OF STRAIN INVARIANTS IN THE KINEMATICS OF CONTINUA.

R.H.Dishington.

Phys. of Fluids, Vol. 3, No. 3, 482 (May-June, 1960).

The three invariants of the rate-of-strain tensor in a fluid element are given a direct interpretation as the contribution to each in turn of the first three time derivatives of volume, measured per unit volume, that arises from the velocity (as distinct from the acceleration) of the deforming surface of the element. J.G.Oldroy

532.5 : 541.1

ANALYSIS OF STEADY-STATE SUPPORTED ONE-DIMENSIONAL DETONATIONS AND SHOCKS. See Abstr. 14109

532.5 : 539.1

14583

ROTATIONAL DIFFUSION CONSTANT OF A CYLINDRICAL PARTICLE.

S.Broersma.

J. chem. Phys., Vol. 32, No. 6, 1626-31 (June, 1960).

The torque constant of a closed cylinder rotating in a viscous medium has been calculated for length (2a) over width (2b) ratios larger than 3.5 to within a first order in b/a. The analysis demonstrates how the contributions to the viscous dissipation tend to be underestimated in hydrodynamic considerations so that the geometrical values deduced from them come out too high. Experimental results for the torque on cylindrical rods and ellipsoids for a/b values from 3.5 to 30 are close to the theoretical results. For $a/b > 10$ the difference is about 10%; for shorter molecules 20%. With the rotational diffusion constant given by $3kT(\sigma - \gamma)/8\pi\eta a^3\omega$, where $\sigma = \log 2a/b$ best fit is obtained with $\gamma(\sigma > 2) = 1.57 - 7 \times (1/\sigma - 0.28)^2 \pm 0.2$. Experimental data for the rotational diffusion constant of a cylindrical virus (a/b = 20) in water, obtained by O'Konski and Haltner agree with this result within 10%. The length of the protein fits within 3%.

532.5 : 539.1

14584

VISCOUS FORCE CONSTANT FOR A CLOSED CYLINDE

S.Broersma.

J. chem. Phys., Vol. 32, No. 6, 1632-5 (June, 1960).

The viscous force constant of a moving cylinder closed at the ends has been calculated including first order effects in width (2b)/length (2a). Experimental results, obtained for macroscopic models, are in essential agreement with this. For $a/b > 20$ the discrepancy is about 8%, for shorter cylinders near 20%. With the force on a cylinder moving sideways given by $F = 8\pi\eta av/(\sigma - \gamma)$, where $\sigma = \log 2a/b$, it is found that $\gamma(\sigma > 2) = 0.35 - 4(1/\sigma - 0.43)^2 \pm 0.2$. For a translation lengthwise, with $F = 4\pi\eta av/(\sigma - \gamma)$, the relation $\gamma(\sigma > 2) = 1.30 - 8(1/\sigma - 0.30)^2 \pm 0.2$ holds.

532.5

14585

ON THE DRAG ON A RIGID SPHERE MOVING IN A VISCOUS LIQUID INSIDE A CYLINDRICAL TUBE.

T.Bohlin.

K. Tekn. Högsk. Handl., No. 155, 64 pp. (1960).

The drag on a small rigid sphere, moving slowly along the axis of a cylindrical tube in a viscous liquid, is computed by solving the linear parts of the Navier—Stokes equations. The drag is expressed as a power series expansion in the ratio of sphere radius to cylinder radius.

532.

14586

THEORY OF MOTION OF A CYLINDER ON A SURFAC COVERED BY A LAYER OF VISCOPLASTIC LUBRICAN

L.I.Kotova.

Zh. tekh. Fiz., Vol. 27, No. 7, 1540-57 (July, 1957). In Russian.

The Shvedov—Bingham equation is integrated for the case of such motion and a differential equation for the hydraulic pressure p s obtained. This equation is solved approximately for dp/dx and appropriate solutions, satisfying boundary conditions, are selected. This allows to obtain distribution of pressure in the oil layer, its carrying capacity and its expenditure rate due to friction. The solution is general and can be particularized for an ideally viscous or an ideally plastic oil. J.K.Skwirzynski

532.5

14587 THE CALCULATION OF FLOW OF A GASIFIED LIQUID WITH TWO-PARAMETER PERMEABILITY CHARACTERSTICS. D.A.Efros and I.F.Kuranov.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 553-6 (May 21, 1960). In Russian.

The theory of flow of a gasified liquid in a porous medium is developed assuming the permeabilities of the gas and the liquid to depend on both degree of saturation and pressure. Curves of flow against pressure in the steady and unsteady states are calculated for two petroleums of different properties, and compared with the curves obtained assuming the permeability to be a function of saturation only. R.F.S.Hearmon

532.5

14588 NEW VARIATIONAL PRINCIPLE FOR INCOMPRESSIBLE NON-NEWTONIAN FLOW. R.B.Bird.

Phys. of Fluids, Vol. 3, No. 4, 539-41 (July-Aug., 1960).

A variational principle is given which describes the steady laminar motion of simple non-Newtonian fluids, for which the viscosity is a function of the second invariant of the rate of deformation tensor. This principle simplifies to von Helmholtz's principle for the Newtonian fluid, and to Tomita's principle for the Ostwald—de Waele fluid. For the latter two types of fluids, the equations of continuity and motion are equivalent to the statement that the rate of entropy production in the system is a minimum; for more general fluids, the variational principle does not admit this simple interpretation.

532.5

14589 THE EFFECT OF NONISOTHERMICITY ON THE HYDRAULIC IMPEDANCE IN THE LAMINAR MOTION OF TRICKLING LIQUIDS. E.A.Sidorov.

Zh. tekh. Fiz., Vol. 28, No. 12, 2711-12 (Dec., 1958). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 3, No. 12, 2480-2 (Dec., 1958).

This paper is an account of experimental proof of two formulae developed in a previous paper [Zh. tekh. Fiz., Vol. 27, No. 2, 327 (Feb., 1958)]. One was for the velocity distribution, near the walls of a tube, for stabilized laminar flow: $v = uv_0\alpha\dot{y}/R$, where v_0 = average velocity of liquid (calculated from volume flow), $y = r - R$, the radial coordinate, R = radius of tube, and α is a factor which allows for change in viscosity due to nonisothermicity. The other equation is for the flow of heat between walls and liquid. In the experiments, in which water was used as the liquid, agreement with these equations to within 1% was obtained. T.C.Toye

532.5

14590 CONSTANT SHEAR FLOW PAST TWO CIRCULAR CYLINDERS. L.N.Nigam.

Z. angew. Math. Phys., Vol. 10, No. 6, 584-92 (1959).

Studies the location of the stagnation points and their shift when a non-dimensional parameter $N = U/\omega c$, (where U and c are a typical velocity and length and ω is the vorticity) is varied from 0 to ∞. The problem has been studied using orthogonal curvilinear dipolar coordinates and the location of the stagnation points for different values of N has been found. The forces on the cylinders are calculated.

532.5

14591 A LAMINAR BOUNDARY LAYER ON A PLATE SITUATED IN A NON-UNIFORM STREAM. O.N.Obchinnikov.

Zh. tekh. Fiz., Vol. 30, No. 6, 627-38 (June, 1960). In Russian.

Reports a study of development of a dynamical and thermal boundary layer on a plate situated in a stream of viscous, incompressible fluid which has transverse gradients of velocity and temperature. The analysis is performed by means of the asymptotic layer concept and the solution is formulated as a series of integral powers of the square root of the Reynolds number. It is shown that even a small non-uniformity of the stream has appreciable influence on the values of parameters of the dynamical and thermal boundary layer when the Reynolds and Prandtl numbers are small. J.K.Skwirzynski

532.5

14592 TURBULENCE THEORY AND FUNCTIONAL INTEGRATION. I. G.Rosen.

Phys. of Fluids, Vol. 3, No. 4, 519-24 (July-Aug., 1960).

An integral representation of the general solution to the Hopf Φ equation is reported. Integral representations for the spatial correlation functions are derived from the characteristic functional Φ. These exact results are applied to Navier—Stokes fluid turbulence.

532.5

14593 TURBULENCE THEORY AND FUNCTIONAL INTEGRATION. II. G.Rosen.

Phys. of Fluids, Vol. 3, No. 4, 525-8 (July-Aug., 1960).

Proofs are given which show that the integral representations for the Navier—Stokes spatial correlation functions satisfy the reality conditions, the continuity conditions, and the Navier—Stokes condition. With the aid of the integral representations for the correlation functions an analysis of the decay of homogeneous turbulence is developed. For the initial period of decay the theory predicts the empirical law $u^2 \propto \nu(t'' - t')^{-1}$, as well as a universal and shape-preserving two-point correlation tensor.

532.5

14594 ENERGY TRANSFER IN A TURBULENT FLUID. B.S.Tanenbaum and D.Mintzer.

Phys of Fluids, Vol. 3, No. 4, 529-38 (July-Aug., 1960).

A method is introduced by which experimental measurements of two- and three-velocity correlation functions can be used to provide a direct test of energy transfer hypotheses in a turbulent fluid. By using this method, the optimal values for the three empirical parameters m, n, and γ, which appear in the general transfer function proposed by von Kármán, are determined from the correlation function data of Stewart and Townsend. This optimal transfer function is found to be:

$$T_{\mathrm{optimal}}(k) = 1.2[k^{-5/2}E^{1/4}\int_0^k k'^3E^{5/4}(k')dk' - k^3E^{5/4}\int_k^\infty k'^{-5/2}E^{1/4}(k')dk'],$$

and a comparison, based on the data, is made between this transfer function and transfer functions proposed by Heisenberg and Kovasznay.

532.5

14595 A STUDY OF THE TURBULENT BOUNDARY LAYERS. A Kieda.

Sci. Engng Rev. Doshisha Univ., Vol. 1, No. 1, 1-172 (March, 1960). In Japanese.

Several analyses of the incompressible turbulent boundary-layers are discussed on the basis of the velocity defect law of Rotta and Coles. The disitributions of the shearing stress are calculated from the momentum equation. The parameters describing the layer development are investigated in detail using both the experimental results of the author and other published data. A practical method is proposed for the calculation of the thickness development, local skin friction and for making an estimation of the risk of separation. Some examples are given.

532.5

14596 ULTRASONIC INVESTIGATIONS ON LIQUID SURFACES. G.Keck.

Acustica, Vol. 7, No. 5, 310-12 (1957). In German.

When an ultrasonic generator is lifted out of a liquid surface, it draws a column of liquid with it. Observations on such liquid columns are reported.

532.5 : 534.23

14597 ACOUSTIC PRESSURE VARIATION AND THE SPECTRUM IN OSCILLATORY CAVITATION. L.Bohn.

Acustica, Vol. 7, No. 4, 201-16 (1957). In German.

The pressures and sound spectra for cavitation set up in the focus of a transducer array of 15 kc/s are measured with a magnetostrictive probe. In weak cavitation, bubbles are formed and set in oscillation at their natural frequencies. They stabilize themselves with a definite radius (depending on air content), which can lie below that for resonance with the source, and burst under strong excitation. In hard cavitation strong pressure pulses are set up, which mainly influence the noise spectrum. Other matters considered are the relationship between pulse and excitation; pulse form and duration; statistical fluctuations from the mean position.

532.5 : 534.23

14598 CINEMATOGRAPHIC INVESTIGATIONS OF OSCILLATORY CAVITATION. E.Mundry and W.Güth.
Acustica, Vol. 7, No. 4, 241-50 (1957). In German.

Cavitation bubbles were produced from a nickel transducer operating at 2.5 kc/s and photographed at from 12 500 to 105 000 frames/sec. In aerated water and moderate sound fields, bubbles are observed to vibrate in a mode indicating a combination of nonlinear forced vibration and sudden excitation at the natural frequency. In stronger fields both in aerated and degassed water a large number of tiny bubbles, which almost disappear during the time-period of one oscillation, are seen. The strong shock waves accompanying this phenomenon were photographed in a schlieren system.

532.5 : 534.23

14599 OSCILLATORY CAVITATION WITH SHORT SONIC PULSES. W.Mohr.
Acustica, Vol. 7, No. 5, 267-77 (1957). In German.

The cavitation process from the growth of the nuclei to the proper cavitation oscillation may be analysed on a time base by utilizing sound pulses (20 to 5000 μs). The compression waves originating from the oscillating cavities during a pulse are recorded electrically and used as a statistical measure for the cavitation. Dark field observation together with photographic recording completes the investigation. Cavitation is examined as a function of (a) pulse length and intensity of sound; (b) pulse interval, and (c) gas content of the fluid (water). During the growth of the nuclei the cavitation effect increases proportionally to pulse length. The characteristic of this effect becomes steeper at the beginning of the cavitation oscillations. As a result of the radiation pressure, shorter pulse intervals cause a lower density of nuclei in the sound field, and therefore cavitation becomes weaker. If the water contains gas and the pulse intervals are short enough, cavitation will recommence (secondary cavitation) depending on the relative gas content of the fluid.

532.5

14600 ON THE SECONDARY MOTION INDUCED BY OSCILLATIONS IN A SHEAR FLOW. D.J.Benney and C.C.Lin.
Phys. of Fluids, Vol. 3, No. 4, 656-7 (July-Aug., 1960).

Non-linear effects of a small oscillatory disturbance of a shear flow are discussed, by examining the terms in the velocity and pressure that are of the second degree in the amplitude. The prediction of the formation of longitudinal vortices, in addition to a two-dimensional secondary flow, is in agreement with experiment and might throw light on the transition from laminar to turbulent flow.
J.G.Oldroyd

532.5

14601 OSCILLATIONS OF AN INCOMPRESSIBLE FLUID SPHERE OF VARYING DENSITY. S.K.Trehan.
Astrophys. J., Vol. 132, No. 1, 264-8 (July, 1960).

The oscillations of a self-gravitating incompressible fluid sphere of varying density have been investigated. It is found that, for the same total mass, a sphere of uniform density has a longer period of oscillation than a sphere of varying density.

532.5

14602 ROTATORY OSCILLATION OF AN INFINITE PLATE IN NON-NEWTONIAN FLUIDS. A.C.Srivastava.
Appl. sci. Res. A, Vol. 9, No. 5, 369-73 (1960).

The equations of motion for an infinite plate performing rotatory oscillations in non-Newtonian (Reiner—Rivlin) fluids have been integrated approximately. It is found that in Newtonian fluids the axial flow at infinity is of oscillatory type and the effect of cross-viscosity is to increase the amplitude of the oscillation of the axial velocity at infinity.

532.5

14603 VISCOUS DISSIPATION OF SHALLOW WATER WAVES. C.E.Grosch, L.W.Ward and S.J.Lukasik.
Phys. of Fluids, Vol. 3, No. 3, 477-9 (May-June, 1960).

Measured attenuation of waves with distance travelled, in a 75 ft-square basin filled to a depth of 3.75 in. of water, is greater than that predicted from the linearized Navier—Stokes equations. After correction for lateral spreading (in a motion which is not two-dimensional), the observed attenuation coefficient is of the order of 2-5 times the predicted value.
J.G.Oldroyd

532.

14604 AN ANALYSIS OF CRITICAL SIMULTANEOUS GAS/LIQUID FLOW THROUGH A RESTRICTION AND ITS APPLICATION TO FLOWMETERING. N.C.J.Ros.
Appl. sci. Res. A, Vol. 9, No. 5, 374-88 (1960).

A theoretical analysis is presented of the mechanism of simultaneous flow of gas and liquid through a restriction at critical speed The study shows that a relationship exists between the mass flows o gas and liquid, restriction size and upstream pressure. Compariso of this relationship with measurements showed a reasonable agreement. It has therefore been concluded that a restriction can be use as a gas/liquid flowmeter with reasonably high accuracy, provided that the flow is a critical one. Further increase of accuracy seems possible by using a restriction especially designed for the purpose.

532.

14605 TRACING OF WATER FLOW BY MEANS OF RADIOACTIVE ISOTOPES AND SCINTILLATION COUNTERS. D.E.Hull.
Internat. J. appl. Radiation and Isotopes, Vol. 7, No. 3, 260 (Jan., 1960).

The use of Geiger counters for the tracing of water flow by means of radioactive isotopes is discussed and their performance is compared with that of a scintillation counter - similar to the one described by Ljunggren et al. [Internat. J. appl. Radiation and Isotopes, Vol. 5, No. 3, 204 (May, 1959)]. It is shown that although scintillation counters excel in some features and Geiger counters in others, they do not differ greatly in sensitivity with large volumes.
C.F.Barnaby

532.5 : 621.317.39

14606 AN INSTRUMENT FOR MEASURING LIQUID LEVEL AND SLOSH IN THE TANKS OF A LIQUID-PROPELLANT ROCKET. L.B.Wilner, W.L.Morrison and A.E.Brow
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 786-8 (April, 1960).

A measuring system for monitoring dynamic level variations in red fuming nitric acid is discussed. The system employs a continuous variable-capacitance sensor with a tuned-circuit capacitance detector. The transistorized, temperature-stabilized capacitance detector is discussed in detail. Performance data are presented.

532.5 : 539.17

HYDRODYNAMICS OF A LIQUID POISON SCRAM SYSTEM FOR REACTORS. See Abstr. 13372

532.6

14607 INSTRUMENT FOR AUTOMATIC RECORDING OF SURFACE TENSION. V.Jackman.
Analyt. Chem., Vol. 32, No. 8, 1055 (July, 1960).

The use of a portable recording tensile testing machine is described for the measurement of surface tension by the du Notty method. A load cell (0 to 4.25 g) has performed well at a sensitivity setting of 0.5g full scale. A strain gauge related a mechanical loading to a proportional electrical signal.
R.Schnurmann

532.6

14608 COMMENTS ON A RUPTURED SOAP FILM. F.E.C.Culick.
J. appl. Phys., Vol. 31, No. 6, 1128-9 (June, 1960).

The work done in accelerating parts of the film is taken into account in an attempt to reconcile Ranz's experimental results (Abstr. 931 of 1960), on the speed of opening of a hole in a horizontal soap film, with Rayleigh's theory.
J.G.Oldroyd

532.6

14609 MORE EXPERIMENTS ON LIQUID FILMS. R.M.Koros, J.Deckers and M.Boudart.
J. appl. Phys., Vol. 31, No. 6, 1129-30 (June, 1960).

Measurements of electrical conductivity were made on thin films formed when two opposing jets collided, e.g. different jets of aqueous solutions of barium hydroxide and sulphuric acid, respectively. It is deduced that there is some mixing and momentum loss in the region of impact, but that neither occurs in the film itself.
J.G.Oldroyd

532.6

14610 THE COALESCENCE OF LIQUID DROPS WITH FLAT LIQUID/LIQUID INTERFACES. G.E.Charles and S.G.Mason.
J. Colloid Sci., Vol. 15, No. 3, 236-67 (June, 1960).

A liquid drop (Phase 1) falling through a lighter liquid (Phase 2) n to a Phase 1/Phase 2 interface rests at the interface for a ime τ before coalescing with the underlying phase. In a given ystem τ follows a roughly Gaussian distribution between τ_{min} nd τ_{max}. Results obtained with oil/water systems corroborate number of earlier findings, e.g. stability increases with decrea-ing temperature and with increasing drop size. With oil/water ystems, τ was markedly reduced when the drop contained small mounts of a diffusing component, when an electrostatic field was pplied, or when the interface was contaminated with solid particles. igh-speed cine-photographs of the Phase 2 film between the drop nd interface showed that rupture does not always occur at the ame position in the film and can occasionally occur at two places imultaneously. The expansion of the radius of the "hole" was apid and generally decreased with time. The results from film upture studies suggest that rupture of the Phase 2 film occurs ver a range of thicknesses. The experimental data were analysed sing equations derived for drop deformation, film thinning, and ilm rupture. The limitations of these equations are discussed n detail.

532.6

14611 THE OSCILLATIONS OF A VISCOUS LIQUID DROP.
W.H.Reid.

Quart. appl. Math., Vol. 18, No. 1, 86-9 (April, 1960).

The damped oscillations of an isolated mass of viscous liquid whose (approximately) spherical shape is maintained by surface tension are identical with those in the classical case when self-gravitation maintains the spherical shape. In drops of water in air, aperiodic damping of the principal mode of oscillation will occur at radii less than about 0.23 mm. J.G.Oldroyd

532.6 : 541.13

14612 FORMATION OF MERCURY DROPS AT THE BOTTOM END OF A CAPILLARY. CASE OF VERY SMALL PRESSURES.
F.Chao-Ortega and D.Laforgue-Kantzer.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 219-21 (July 11, 1960). In French.

The current—time curves of a dropping mercury electrode have a significantly different shape when $P > 2\sigma/\rho$ and $P < 2\sigma/\rho$, where σ is the interfacial tension mercury/solution and ρ the radius of the bore of the capillary. For $P < 2\sigma/\rho$ there is a "dead period" between the current peaks of consecutive drops. This can be explained as corresponding to the hanging drop period with wetting liquids. R.Schnurmann

532.6

14613 THE SURFACE TENSION OF ETHYL ALCOHOL.
M.Borneas and I.Băbuţia.

Acta Phys. Polon., Vol. 18, No. 5, 521-2 (1959). In French.

The surface tension of ethyl alcohol was measured between 6.5 and 13°C with the Lecomte du Noüy method. Larger values were found when the liquid rotated than when it was still. In the latter case the angle at which the ring broke away from the surface of the liquid decreased linearly with temperature, whereas the curve for the rotating liquid showed a minimum at about 10°C which lay close to the line for the static measurements. The Eötvös—Ramsay—Shields equation did not hold when the liquid is rotated. R.Schnurmann

532.6

14614 MEASUREMENT OF INTERFACIAL TENSION BETWEEN THE TWO PHASES OF A COACERVATE BY THE STIRRUP METHOD.
L.P.Guastalla and J.Guastalla.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4304-6 (June 27, 1960). In French.

The limitation in the measurement of small interfacial tensions when there is no complete preferential wetting by one of the liquids, becomes apparent with the stirrup method as soon as the maximum height of the meniscus is no larger than the diameter of the horizontal wire. For the system gelatin—resorcin a lower limit of 0.08 dyne/cm was found. The temperature was maintained within ±1°C, and the measurements were made at 70°C. R.Schnurmann

532.6 : 541.18

14615 CONTRIBUTION TO THE STUDY OF THE ADSORPTION OF ACIDS AND ALCOHOLS OF SATURATED STRAIGHT-CHAIN HYDROCARBONS.
L.Guastalla.

Ann. Phys. (Paris), Ser. 3, Vol. 5, No. 1-2, 131-80 (Jan.-Feb., 1960). In French.

Experimental techniques for measuring the wetting hysteresis of paraffin wax and water are described. By a difference method the adsorption of acids and alcohols in the surface of the water and on wetted paraffin wax were measured. The Traube coefficient for C_2 to C_{12} acids and C_3 to C_{10} alcohols is 2.65-2.7 corresponding to a wetting energy per CH_2 group of (390 ± 5) × 10^{-16} erg. This is independent of the active group. R.Schnurmann

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

532.7

14616 THEORY OF CLASSICAL FLUIDS: HYPER-NETTED CHAIN APPROXIMATION. I. FORMULATION FOR A ONE-COMPONENT SYSTEM.
T.Morita.

Progr. theor. Phys., Vol. 20, No. 6, 920-38 (Dec., 1958).

Several attempts have been made to take account of terms corresponding to large graphs in the cluster expansion formulae for the free energy and the radial distribution function, for the purpose of applying them to a dense gas or to a liquid. Here an approximation is proposed which includes the approximations in the past as the first or second approximation, by taking account of graphs which can be easily evaluated by means of the Fourier transformation. The graphs taken into account are all those which can be constructed starting from a line or a ring by a sequence of processes to replace a constituent line by a watermelon shape; in the course of the replacement, a line in a watermelon shape is also replaced by a watermelon. The approximation is called the "hyper-netted chain" approximation. Formulae are obtained for the free energy and the radial distribution function. The expansion formulae for the free energy and the radial distribution function, obtained by means of the "hyper-netted chains", are also presented. They contain the results in the hyper-netted chain approximation as their leading terms. Another set of formulae in the hyper-netted chain approximation is given and compared with the theories for ionic systems.

532.7

14617 THEORY OF CLASSICAL FLUIDS: HYPER-NETTED CHAIN APPROXIMATION. II.
T.Morita.

Prog. theor. Phys., Vol. 21, No. 3, 361-82 (March, 1959).

Formulae for the free energy and the radial distribution function in the hyper-netted chain approximation are obtained for multi-component systems. The expansion formulae by means of the hyper-netted chains are also given for them, and also for the potentials of average force of n particles. Another expansion scheme is given which is suitable for comparison with previous theories of ionic solutions. The ring and watermelon approximations in this scheme are discussed in detail for the Coulomb potential and the Coulomb potential with hard core.

532.7

14618 FLOW ANISOTROPY AND THE BOUNDARY CONDITIONS IN THE MOLECULAR THEORY OF LIQUIDS.
J.V.Champion and A.Suddaby.

Proc. Phys. Soc., Vol. 75, Pt 5, 799-802 (May, 1960).

The relative merits are discussed of the "strong" and "weak" boundary conditions on the Smoluchowski differential equation for the distortion of the relative pair distribution in the steady non-uniform state of a liquid. Estimates of optical anisotropy (double refraction) based on the alternative boundary conditions in the case of chloform differ by a factor of 25; the strong condition (corresponding to a singularity at the orgin) gives good agreement with experiment. J.G.Oldroyd

532.7

14619 BROWNIAN MOTION IN LIQUIDS.
G.Mandel and F.C.Collins.

J. chem. Phys., Vol. 32, No. 6, 1796-1801 (June, 1960).

The time derivative of the frictional force acting on a single molecule derived by Collins and Raffel (Abstr. 1143 of 1959) was ambiguous with respect to a sign which left uncertain whether the calculated ensemble average velocity would decay exponentially in time or be initially sinusoidal in behaviour. This point is now resolved and the exponential decay of the velocity is obtained for a molecule relaxing for an initial steady state. The frictional coefficient is also obtained by an alternative method involving an expansion of the conditional second-order phase density in powers of the distance that the representative molecule travels before its ensemble average velocity decays to zero. The alternative derivation enables the velocity dependence of the frictional coefficient to be examined. An approximate evaluation of the corrected velocity-dependent frictional coefficient for liquid argon averaged over all velocities is in improved agreement with the value calculated from the self-diffusion measurements of Corbett and Wang.

532.7

14620 ON THE KIRKWOOD SUPERPOSITION APPROXIMATION. R.Abe.

Progr. theor. Phys., Vol. 21, No. 3, 421-30 (March, 1959).

The Kirkwood superposition approximation is investigated by making use of the expansion theorem for the potential of average force and its correction term is found in a form of the expansion in powers of particle number density ρ. The lowest order term of this correction is calculated for a special configuration of three particles in a fluid consisting of hard spheres and the Kirkwood approximation is shown to overestimate the distribution function of triplets in this case. The Kirkwood integral equation with correction is solved by expanding the radial distribution function in powers of ρ. The solution thus obtained is shown to be exact up to the order of ρ^2, while the Kirkwood approximation itself does not yield the correct term of the order of ρ^2. It is shown that the distribution function of triplets can, in principle, be expanded in terms of radial distribution functions and a few terms of this expansion are calculated explicitly, of which the first term just corresponds to the Kirkwood superposition approximation.

532.7

14621 A NOTE ON THE BORN–GREEN LINEARIZED INTEGRAL EQUATION. S.Katsura and K.Harumi.

Proc. Phys. Soc., Vol. 75, Pt 6, 826-32 (June, 1960).

This paper is concerned with the validity of Green's linearized integral equation, or the ring approximation of the virial expansion, in the theory of liquids. It is shown that this approximation is applicable only at high temperatures and low densities, and by comparing the solution of Green's linearized equation with the exact solution by Gürsey for the one-dimensional square-well potential, that the singularities in Green's equation are attributed to the linear approximation and have nothing to do with the phase transition. The situations are the same in the approximation of Kirkwood (linearized form), of Abe, of Morita, and of Meeron.

532.7

14622 RADIAL DISTRIBUTION FUNCTIONS FROM THE BORN–GREEN INTEGRAL EQUATION. A.A.Broyles.

J. chem. Phys., Vol. 33, No. 2, 456-8 (Aug., 1960).

Comparisons are made between solutions to the Born–Green integral equation and radial distribution functions obtained by the Monte Carlo method by Wood and Parker (Abstr. 7668 of 1957) for the Lennard-Jones potential. It is observed that multiplying the particle separation in the Born–Green case by a constant factor improves the agreement for loops beyond the first.

532.7

14623 QUANTUM EFFECT ON THE RADIAL DISTRIBUTION FUNCTION OF LIQUIDS. F.P.Ricci.

Nuovo Cimento, Vol. 16, No. 3, 532-8 (May 1, 1960).

This is analysed by means of the corresponding states principle. Also the best mode for describing liquid helium is discussed.

532.7 : 541.18

14624 DISTRIBUTION FUNCTIONS OF A FLUID IN AN EXTERNAL POTENTIAL FIELD: APPLICATION TO PHYSICAL ADSORPTION. W.A.Steele and M.Ross.

J. chem. Phys., Vol. 33, No. 2, 464-70 (Aug., 1960).

The thermodynamic properties of a fluid in an external potential field are expressed in terms of the spatial distribution functions appropriate to the fluid. Several methods of computing these distribution functions are given: integro-differential equations analogous to the Born–Green–Yvon equations; integral equations analogous to the Kirkwood–Salsburg equations; and two approximate methods of computation based on a perturbation approach. The applicability of these methods of calculation to various aspects of the problem of physical adsorption is discussed.

532.7

14625 A SIMPLE MOLECULAR-STATISTICAL THEORY OF THE NEMATIC LIQUID CRYSTALLINE PHASE. II.

W.Maier and A.Saupe.

Z. Naturforsch., Vol. 15a, No. 4, 287-92 (April, 1960). In German.

The theory discussed in Pt I (Abstr. 5007 of 1960) is supplemented by the introduction of a close-ordering parameter. A clear relationship is obtained between the sudden volume change occurrin during transition into the isotropic liquid phase and the degree of ordering to which the nematic phase tends when approaching the transition point. F.Lachman

532.7

14626 STRUCTURE OF GLASS-FORMING HALIDES. II. LIQUID ZINC CHLORIDE.

J.D.MacKenzie and W.K.Murphy.

J. chem. Phys., Vol. 33, No. 2, 366-9 (Aug., 1960).

For Pt I, see Abstr. 6777 of 1960. Measurements of viscosity and electric conductivity in liquid zinc chloride indicate that at temperatures near the melting point, the melt is associated. The degree of association diminishes rapidly with increasing temperatur as shown by the decreasing energies of activation for both viscous flow and conduction. Liquid $ZnCl_2$ is thus not a normal fused salt such as $CdCl_2$ or $MgCl_2$. From the crystal structure and Raman absorption spectra, a mechanism of fusion and the structure of the melt are postulated. The ease of glass formation is discussed in terms of the liquid structure.

532.

14627 STRUCTURE OF THE COMPLEX ION IN AQUEOUS SOLUTIONS OF ZIRCONYL AND HAFNYL OXYHALIDE

G.M.Muha and P.A.Vaughan.

J. chem. Phys., Vol. 33, No. 1, 194-9 (July, 1960).

X-ray scattering by aqueous solutions of $MOX_2.8H_2O$ (M = Zr an Hf, X = Cl and Br) can be explained if one assumes the existence of a complex $[M_4(OH)_8(H_2O)_{16}]X_8$. The metal atoms in this complex are arranged in a square and are held together by double OH bridge along each edge. In addition, each metal atom is bound to four additional water molecules in such a manner that the configuration about the metal is a square Archimedes antiprism. The halogen ions are not bound directly to the metal. They do, however occupy definite positions in the complex, and are presumably held in place by electrostatic forces. The structure is very similar to that which has been found in the crystalline oxyhalides.

532.

14628 THEORY OF FUSED SALTS. F.H.Stillinger, Jr, J.G.Kirkwood and P.J.Wojtowicz.

J. chem. Phys., Vol. 32, No. 6, 1837-45 (June, 1960).

The properties of ionic pair distributions are investigated for a simple fused-salt model. The short-range ion core forces are assumed to be identical for both anions and cations and, although the method is capable of handling mixtures of ions with different charge only a single fused salt of the symmetrical valence type is consider A set of relations is developed to describe the asymptotic behaviour (for large ion distances) of the ion pair distribution functions. Thes relations are obtained with benefit only of certain weak, plausible assumptions concerning the triplet superposition defects; as a consequence, the usual superposition approximation of liquid theory is circumvented. A significant feature of the results is prediction of concentric shells of average charge density surrounding a given ion in a manner suggesting local latticelike structure.

532.

14629 THEORY OF DILUTE POLYMER SOLUTION. III. HETEROGENEOUS POLYMER.

H.Yamakawa and M.Kurata.

J. chem. Phys., Vol. 32, No. 6, 1852-60 (June, 1960).

For Pt II see Abstr. 8620 of 1958. The second virial coefficien of osmotic pressure and light scattering of heterogeneous chain polymer solutions are calculated to the double-contact approximati Two types are assumed for the molecular weight distribution: the Schulz distribution, and the distribution with two deltalike peaks. Then, the heterogeneity corrections for intrinsic viscosity are eval ated on the assumption of the Schulz distribution. On the basis of th results obtained, a tentative attempt is made at interpreting the pro portionality between the intrinsic viscosity at the θ temperature and the square root of the molecular weight without discarding the hydr dynamic scheme, and the relation between the hydrodynamic and statistical radii of heterogeneous polymer coil is also examined. Finally, the relation between the second virial coefficient A_2 and intrinsic viscosity $[\eta]$ is discussed somewhat in detail. And it is shown that the initial curvature of the curve of $[\eta]/[\eta]_\theta - 1$ versus $A_2M_W/[\eta]_\theta$ is concave upward for ordinary fractionated samples, where $[\eta]_\theta$ is the intrinsic viscosity at the θ temperature, and M_W is the weight-average molecular weight. This statement is verified by comparison with experiment.

532.7

14630 THERMAL DIFFUSION IN LIQUIDS.

T.Mizushina, S.Iuchi, R.Ito and O.Yoshikawa.

ech. Rep. Engng Res. Inst. Kyoto Univ., Vol. 10, No. 2 [Rep. No. 6], 27 pp. (March, 1960).

Experiments with sugar solutions indicate that the Korsching ell is more reliable than the Tanner cell which has greater width. ight inclination of the cell causes larger convection with the anner cell. R.Schnurmann

532.7

14631 ON THE THEORY OF SELF-DIFFUSION IN LIQUID METALS. R.A.Swalin.

cta metallurgica, Vol. 7, No. 11, 736-40 (Nov., 1959).

The theory of diffusion in liquids is considered from the stand-oint of fluctuation theory. It is postulated that diffusion results from e movement of atoms small and variable distances as a result of ocal density fluctuations. From geometrical considerations it is educed that about four atoms besides the diffusing atom are volved in such a fluctuation. The energy of a fluctuation is expressd in terms of the Morse function. The following equation is derived or D, the self-diffusion coefficient

$$D = 1.29 \times 10^{-8}\ T^2/\Delta H_V \alpha^2\ \text{cm}^2/\text{sec}$$

here ΔH_V is the heat of vapourization and α is related to the urvature of the potential versus distance curve. The theory results there being no activation energy for the diffusion process but a lot of log D versus 1/T yields an apparent straight line over a mall temperature interval, the slope of which is not a function of e properties of the element but only a function of the temperature f measurement. The relative value of D for various elements is a unction of the properties of the elements, however. The theory is ompared with experimental results with the agreement being enerally quite good. It also follows that there is no activation olume in the usual sense but what is measured in pressure experients, according to the theory, is the effect of pressure on the agnitude of fluctuations. The theory, if correct, also implies that ermodynamic properties such as the partial molar heat of solution re important in solute diffusion and may be more important than olute atomic size effects.

532.7

14632 SELF-DIFFUSION IN THE PRIMARY ALCOHOLS.

D.W.McCall and D.C.Douglass.

J. chem. Phys., Vol. 32, No. 6, 1876-7 (June, 1960).

Self-diffusion coefficients for n-propanol, n-butanol and n-octanol were measured at 25° C by the spin-echo method. The new values correct earlier data (Abstr. 12488 of 1959) and now agree with he values obtained by the tracer method. J.G.Powles

532.7

14633 THE VARIATION OF THE COEFFICIENT OF DIFFUSION BY TRANSLATION WITH THE VISCOSITY OF THE SOLVENT: CORRECTION TERM TO EINSTEIN'S LAW. R.Cerf.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3599-601 (May 30, 1960). In French.

Experimentally the coefficient of diffusion D is always inversely proportional to the coefficient of viscosity η as should follow from Einstein's relation D = kT/f, where f is the coefficient of friction. Since the forces on a small molecule in laminar flow differs from those on the molecule during diffusion, Langevin's equation should be modified perhaps by the inclusion of an additional resistance term derived from a periodic potential function E(x). The deviation from Einstein's law for a particular (parabolic) form of E(x) is derived mathematically and the form of D^{-1} as a function of η is discussed.
S.Weintroub

532.7

14634 TRANSPORT PROCESSES IN LIQUID SYSTEMS. III. THERMODYNAMIC COMPLICATIONS IN THE TESTING OF EXISTING DIFFUSIONAL THEORIES.

R.R.Irani and A.W.Adamson.

J. phys. Chem., Vol. 64, No. 2, 199-204 (Feb., 1960).

For previous work, see Abstr. 7839 of 1959. The diffusional and thermodynamic data of the sucrose—water, methanol—benzene and ethanol—benzene systems are used to test and discuss existing diffusion models for liquid systems. The critical dependence of diffusional models on the structure and association in liquids also is discussed. It is also shown how diffusion data can be interpreted to yield useful information on the structure of solutions.

532.7

14635 DIFFUSION OF ^{37}A, Kr, HT IN LIQUID ARGON BETWEEN (84-90)° K. G.Cini-Castagnoli and F.P.Ricci.

Nuovo Cimento, Vol. 15, No. 5, 795-805 (March 1, 1960).

The diffusion of tracers in liquid argon was measured in a wide range of temperatures and under a pressure of 2 atm. The results can be expressed by the following equations:

$$\begin{aligned} D(HT-A) &= 110\ \exp[-312/T] \times 10^{-5}\ \text{cm}^2/\text{sec}, \\ D(A^{37}-A) &\doteq 61\ \exp[-312/T] \times 10^{-5}\ \text{cm}^2/\text{sec}, \\ D(Kr-A) &= 52.5\ \exp[-312/T] \times 10^{-5}\ \text{cm}^2/\text{sec}. \end{aligned}$$

The results of the Brownian motion approach to the transport phenomena are compared with the experimental data on self-diffusion. Binary diffusions are instead discussed on the basis of phenomenological treatments.

532.7

14636 THE DIFFUSION OF POLYBUTYLMETHACRYLATE IN GOOD AND IDEAL SOLVENTS.

V.N.Tsvetkov and S.I.Klenin.

Zh. tekh. Fiz., Vol. 29, No. 11, 1393-9 (Nov., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 11, 1283-9 (May, 1960).

The study of the diffusion of polybutylmethacrylate (PBMA) in chloroform and isopropanol is reported. The functional dependence of the coefficient of diffusion upon concentration for PBMA in chloroform is complex but agrees with the function obtained for other polymers in good solvents. For PBMA in isopropanol, an ideal solvent, the coefficient of diffusion is practically independent of concentration. The relation between the coefficients of diffusion for PBMA in the two solvents and the molecular weights of the fractions used agreed well with the relation between viscosity and molecular weight for the same fractions. The constant $A = \eta_0 D(M[\eta])^{1/3} T^{-1}$ for PBMA in the two solvents was equal, within experimental error, to the value 3.3×10^{-10} ergs/degree found in previous experiments on other polymers. The statistical dimensions of the PBMA molecule could be determined, using the relation $(\overline{h^2})^{1/2} = 2.6 \times 10^{-17}(T/\eta_0 D)$ and plotted against $\sqrt{P}$, where P is the degree of polymerization. The curve obtained coincides with that for polymethylmethacrylate showing that the butyl side chain does not change the thermodynamic flexibility of the molecular chain. R.G.C.Arridge

532.7 : 541.13

14637 REMARKS ON THE PHYSICS OF THE NERNST DIFFUSION LAYER [IN AN ELECTROLYTE].

W.Schlegelmilch.

Z. phys. Chem. (Leipzig), Vol. 214, No. 3-4, 165-78 (1960). In German.

Using the Navier—Stokes equation together with Fick's equation for the rate of change of concentration in a diffusion process, it is shown that with artificial convection (e.g. stirring of the solution) the thickness of the Nernst diffusion layer is independent of the polarizing current and quantity of transported electricity. Without any agitation of the electrolyte and only allowing for natural convection the establishment of stationary conditions is a function of the current and period of polarization. For a diffusion layer of about 10^{-2} cm thickness, containing silver ions, about 10 sec elapse before stationary conditions are established. As, however, the increase in concentration at the electrode is inversely proportional to the square root of the time, and the rate of diffusion shows the same relationship to time, the bulk of the change in concentration takes place in the initial stage. For the purpose of integrating the Fick equation, the same limits can therefore be applied as in the case of artificial convection. R.Schnurmann

532.7

14638 EXCESS PROPERTIES OF H_2-D_2 LIQUID MIXTURES.

M.Lambert.

Phys. Rev. Letters, Vol. 4, No. 11, 555-6 (June 1, 1960).

The heat of mixing (h_e) and excess volume (v_e) of H_2-D_2 mixtures were measured at 20.4° K for several H_2 mole fractions (x). The liquids were in ortho—para equilibrium at 20° K. The results for h_e could be represented within 0.5% by $h_e = 11.8 \times (1-x)$ cal/mole. For v_e the values −0.14, −0.24, −0.16 were obtained respectively for x = 0.300, 0.436, 0.688. Measurements on the ortho—para H_2 system gave for equimolar mixtures at 20.4°: $h_e = 0.4$ cal/mole and $v_e \cong +0.001$ cm^3/mole. H.London

532.7 : 533.7

14639 GAS—LIQUID PHASE EQUILIBRIUM BELOW 0° C IN THE SYSTEM NH_3—N_2—H_2 AND IN THE SYSTEM NH_3—Kr.

A.Michels, E.Dumoulin and J.J. van Dijk.
Physica, Vol. 25, No. 9, 840-8 (Sept., 1959).

Modifications to the apparatus used earlier (Abstr. 3852 of 1951) for work at temperatures −14.90° C to −30.96° C are described and illustrated. An aluminium block is used to surround the equilibrium vessel and an alcohol bath cooled by a freon refrigeration circuit acts as the heat sink. The results for the system NH_3—N_2—H_2, shown in graphical and tabular forms, indicate that Raoult's law breaks down and that at high pressures the vapour pressure of ammonia is increased several times by the presence of the inert gas. For the system NH_3—Kr measurements were made at −5.1° C and −20.1° C only and up to pressures of 175 atm and 200 atm respectively. S.Weintroub

532.7

14640 COMPRESSIBILITIES OF AQUEOUS NITRATE SOLUTIONS.

S.V.Subrahmanyam and J. Bhimasenachar.
J. Acoust Soc. Amer., Vol. 32, No. 7, 835-8 (July, 1960).

Ultrasonic velocities in aqueous solutions of $NaNO_3$, KNO_3, $Ca(NO_3)_2 \cdot 4H_2O$, $Sr(NO_3)_2$, $Pb(NO_3)_2$, and $Ba(NO_3)_2$ were determined making use of a variable path interferometer. These solutions have a common nitrate ion. The effects of different cations on the compressibilities are studied and discussed on the basis of coulomb forces.

532.7 : 539.19

14641 OSMOTIC PRESSURE OF MODERATELY CONCENTRATED POLYMER SOLUTIONS.

M.Fixman.
J. chem. Phys., Vol. 33, No. 2, 370-81 (Aug., 1960).

By two methods a linearization and a variational principle, the Born—Green—Kirkwood equation for the radial distribution function is solved approximately and the osmotic pressure of chain-polymer solutions computed at arbitrary concentration. The Gaussian intermolecular potential energy of Flory and Krigbaum is used, and this restricts the range of validity of the theory to volume fractions less than one-tenth. It is shown how the distribution of polymer molecules in the solvent becomes random as the concentration is increased. For good solvents, the quantity $[(P/c^2) - RT/Mc]$, where P is the osmotic pressure and M the molecular weight, is predicted to increase rapidly with concentration c, and then to level off rapidly, the whole effect being accomplished at quite low concentrations as the molecules are forced to overlap. Some experimental corroboration is displayed. Severe doubt is cast on the practicality of the virial expansion of P, and possibly on the validity, beyond quite low concentrations.

532.7 : 537.3

14642 EQUILIBRIUM SPACE CHARGE AT THE CONTACT OF A METAL AND A PURE HIGHLY INSULATING LIQUID AND ITS INFLUENCE ON HIGH-FIELD CONDUCTIVITY.

M.J.Morant.
J. Electrochem. Soc., Vol. 107, No. 8, 671-7 (Aug., 1960).

The high-field conduction of a highly purified insulating liquid such as hexane may be largely influenced by electron emission from the cathode. Theoretical interpretations have so far neglected the fact that in equilibrium a space charge layer will probably exist at the contact of a metal and such a liquid, similar to that at a metal-semiconductor contact. The effect of this cannot be calculated without more information, but it does explain the observations that the conduction currents are relatively insensitive to cathode work function. A novel electrostatic method is described which, it is believed, can directly measure the potential of such an electronic double layer at the contact of a metal and a dielectric.

532.7

14643 CASIMIR COEFFICIENTS AND MINIMUM ENTROPY PRODUCTION.

R.E.Nettleton.
J. chem. Phys., Vol. 33, No. 1, 237-41 (July, 1960).

The rate equations obeyed by scalar relaxation parameters in a liquid are extended to include inertial terms in the form of second-order time derivatives, and the relations containing these terms are then written formally as first-order equations by treating first-order time derivatives as additional parameters. The resulting equations are interpreted thermodynamically as phenomenological relations containing anti-symmetric Casimir coefficients, and this interpretation leads, with application of the Onsager—Casimir reciprocity theorem, to an additional set of phenomonological equations which reduces to those used in an earlier relaxation theory when inertial effects are neglected. In this way, earlier formulae for the bulk viscosity and high-frequency bulk modulus are recovered unchanged. It is also shown why Prigogine's minimum entropy production theorem should no longer hold when one considers inertial effects.

532.7 : 536.

14644 THERMODYNAMICS OF LIQUID Mg—Bi ALLOYS.

J.J.Egan.
Acta metallurgica, Vol. 7, No. 8, 560-4 (Aug., 1959).

Thermodynamic studies were carried out using the e.m.f. meth A cell is described, suitable for measuring Mg activities in this system. Values of the excess partial molar free energy, the relati partial molar free energy, entropy, and enthalpy are listed along with the corresponding integral quantities. The results are compar with previous vapour pressure and calorimetric measurements as well as investigations of the phase diagram. Wagner's interpretati in terms of electronic constitution is consistent with the present data.

532.

14645 THE HEAT OF MIXING IN BINARY SYSTEMS OF MERCURY WITH ZINC, CADMIUM, INDIUM, THALLIUM, TIN, LEAD AND BISMUTH.

F.E.Wittig and P.Scheidt.
Naturwissenschaften, Vol. 47, No. 11, 250-1 (1960). In German.

Exceptions to the general rule that the ξ-function (a function of the heat of mixing and the composition), in binary liquid alloys of metals of sub-group b, depends in a regular fashion on the position of both components in the periodic system, have been noted by the authors in alloys of Hg. The observations, involving the determination of the heat of mixing, were extended to include a further series of Hg alloys, and further exceptions were found to occur.

J.Thewli

532.7 : 530.1

THERMAL CONDUCTIVITY OF A FLUID: AUTO-CORRELATION EXPRESSION. See Abstr. 14545

532.7 : 539.1

14646 THE INFLUENCE OF RADIOACTIVE RADIATION ON THE SOLUTION PROCESS OF A SOLID.

V.I.Spitsy̆n, E.A.Torchenkova and I.N.Glazkova.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 643-5 (May 21, 1960).

The going into solution of $BaSO_4$ labelled with S^{35} was studied. The salt was prepared under standard conditions using $BaCl_2$ and Na_2SO_4 with and without 0.1 N H_2SO_4. The size of the washed and dried crystals was 2.7-8.1 μ. Aliquots of 0.5 g $BaSO_4$ were shaken in 50 ml H_2O at 20 ± 0.5° and the amount in solution estimated from activity measurements of the supernatant and the residue. The general conclusion drawn is that radioactive $BaSO_4$ is more soluble than inactive salt and that its solubility is enhanced in the presence of an excess of either $BaCl_2$ or Na_2SO_4. Maximum solubility is observed when salt containing 1-2 millicuries/g of S^{35} is used. The explanation states that β-decay leads to surface charges, which influence the processes of going into solution. M.Ebert

532.7 : 539.19

14647 NEW METHOD FOR THE CALCULATION OF THE PAI CORRELATION FUNCTION. I.

J.M.J. van Leeuwen, J.Greoneveld and J.de Boer.
Physica, Vol. 25, No. 9, 792-808 (Sept., 1959).

A new method is described to approximate the pair correlation function. A discussion is given of the structure of the Mayer type of diagrams which correspond to the different contributions to the pair correlation function. The method takes into account in the successive steps of the approximation, diagrams of increasing complexity as regards "the basic structure", a concept which is fully defined here. In each step of the approximation an infinity of diagrams, corresponding to density terms up to infinite order, is included. (Numerical calculations are in progress for evaluating the pair correlation function in the "zeroth" approximation, which takes into account all diagrams, which can be obtained by successiv series and parallel connection of subdiagrams, using the single bond as starting element.) It is also possible that the next step in the approximation, including diagrams of a more complex basic structure, can be made with high speed computers.

532.7 : 541.15

PRIMARY PROCESSES IN THE ACTION OF IONIZING RADIATIONS ON WATER: FORMATION AND REACTIVITY OF SELF-TRAPPED ELECTRONS ("POLARONS"). See Abstr. 14136

532.7 : 539.12

14648 **DIFFUSIVE MOTIONS IN WATER AND COLD NEUTRON SCATTERING.** K.S.Singwi and A.Sjölander.

ys. Rev., Vol. 119, No. 3, 863-71 (Aug. 1, 1960).

Using a model of liquid water in which a molecule, in its equili-
ium position, performs an oscillatory motion for a mean time τ_0,
d then diffuses by continuous motion for a mean time τ_1, and re-
ats this sort of motion, the differential scattering cross-section
r cold neutrons has been calculated. It is found that the shape of
e "quasi-elastic" scattering is, in general, not Lorentzian. The
rmula for the broadening of the quasi-elastic peak assumes a
mple form in two limiting cases: in case (a) $\tau_1 \gg \tau_0$, it reduces
the formula derived on the simple diffusion theory; and in case
) $\tau_1 \ll \tau_0$, the broadening is the same as in case (a) if $\kappa^2 D\tau_0 \ll 1$,
d it approaches the asymptotic value $2\hbar/\tau_0$; if $\kappa^2 D\tau_0 \gg 1$, where
is the momentum transferred to the system and D is the diffusion
efficient of water. The observed value of the broadening can be
plained for a value of $\tau_0 = 4 \times 10^{-12}$ sec. In addition, the theoreti-
l quasi-elastic scattering in case (b) has certain interesting fea-
res which are in general agreement with experiment. Inelastic
attering (hindered translations only) of cold neutrons is calculated
ing two different models of water: a gas model and a Debye model;
e results are compared with experiment. The general shape of
th the quasi-elastic and inelastic scattering of cold neutrons and
e magnitude of the diffusive broadening seem to support a quasi-
ystalline model of water.

532.7 : 539.12

14649 **ATOMIC MOTIONS IN WATER BY SCATTERING OF COLD NEUTRONS.**

.J.Hughes, H.Palevsky, W.Kley and E.Tunkelo.

hys. Rev., Vol. 119, No. 3, 872-81 (Aug. 1, 1960).

The inelastic scattering of cold neutrons, of energy about
$\times 10^{-3}$ eV, was used to study the atomic motions in water, mainly
the liquid phase. As a result of the incoherent nature of scat-
ering by protons, the interpretation of the energy changes in terms
atomic motions is particularly simple. The water samples used
ere extremely thin in order to avoid multiple scattering effects.
stead of the smooth distribution in energy of the scattered neutrons
pected for a classical liquid, the experimental results exhibit a
umber of distinct energy changes. The observed transition energies
re (in units of 10^{-3} eV), 61, 21, 8, 5, and 0.5; the first three of
ese agree with Raman spectroscopy results. The highest energy
ansition increases in intensity up to the boiling point, but does not
hift in energy. For water vapour at 20 atm., a smooth energy dis-
ibution is obtained, which agrees well with the theory of Krieger
nd Nelkin. The sharp energy levels observed for liquid water indi-
ate that the molecules do not act as free gas atoms of mass 18; in
e vapour the effective mass is about 4. An elastic peak is obser-
ed that exhibits no spread in energy of the type expected from the
eory of classical diffusive motions. Instead, two small but sharp
eaks are found to correspond to the gain and loss of 0.5×10^{-3} eV
nergy; the nature of the transition corresponding to this energy
hange is unknown. The absence of diffusive broadening shows that
e water molecules remain in one location for a relatively long time,
bout 10^{-12} sec, before undergoing diffusive "jumps". In general, the
resent experiments show that the atomic motions in water are simi-
ar to those in a solid rather than a gas.

532.7 : 539.12

SCATTERING OF SLOW NEUTRONS BY WATER.

ee Abstr. 12941

532.7 : 539.12

14650 **NEUTRON SCATTERING BY FLUIDS AND THE LAW OF CORRESPONDING STATES.** G.H.Vineyard.

hys. Rev., Vol. 119, No. 4, 1150-3 (Aug. 15, 1960).

It is shown that the classical law of corresponding states implies
orrespondences in the time-displaced pair correlations of fluids,
nd also in the cross-section for neutron and X-ray scattering. A
easurement of the scattering at one temperature and pressure by
e fluid of a class of fluids can thus be used to determine the scatte-
ing at corresponding temperatures and pressures of all fluids of the
lass. Other applications, in the study of molecular fluids and in the
eparation of the self-correlation from the general correlation, are
ointed out.

532.7 : 539.12

14651 **LIQUID DYNAMICS AND INELASTIC SCATTERING OF NEUTRONS.** P.G.de Gennes.

hysica, Vol. 25, No. 9, 825-39 (Sept., 1959).

The energy transfers in one collision between a neutron and a liquid are computed by a method of moments. It is shown that, for large momentum transfers, a perfect gas model is correct. For small momentum transfers, a macroscopic description of the density fluctuations in the liquid is applicable. It is in the intermediate region (where diffraction peaks are observed) that the method of moments is most useful. These different experimental situations are discussed for liquids where recoil and quantum effects are negligible, and numerical results are given for argon. An approximation for the so-called autocorrelation function, valid for both long and short time scales and all distances, is also presented.

532.7 : 537.2 : 533.7

14652 **A NON-LINEAR THEORY OF THE ELECTRIC PERMITTIVITY AND REFRACTIVITY OF DIELECTRIC LIQUIDS IN ELECTRIC AND MAGNETIC FIELDS.**

A.Piekara and S.Kielich.

Acta. phys. Polon, Vol. 17, No. 4, 209-38 (1958).

A non-linear theory of molecular orientation effects in gases and liquids. Consideration is given to dielectric polarization, Cotton—Mouton effect, Kerr effect and dielectric saturation in large electric and magnetic fields. J.G.Powles

532.7 : 537.2

14653 **MEASUREMENT OF SPACE DENSITY OF CHARGE IN FLOWING LIQUIDS.** A.Schuringa and C.Luttik.

J. sci. Instrum., Vol. 37, No. 9, 332-5 (Sept., 1960).

A description is given of an instrument for the detection and measurement of the space density of charge in electrically charged flowing liquids, such as white petroleum products. It is based on the measurement of the dielectric displacement at a metal rod placed in the axis of a pipe carrying the liquid under test. The advantage over existent measuring methods is that no pipe-line section or other part of the installation need be insulated.

532.7 : 537.2

134654 **A METHOD FOR MEASURING THE MOBILITY OF IONS IN DIELECTRIC LIQUIDS.** O.Gzowski and J.Terlecki.

Acta phys. Polon., Vol. 18, No. 3, 191-8 (1959).

A direct method of measuring the mobility of current carriers in dielectric liquids has been developed. The method is based on the measurement of the time of arrival at the electrodes of a layer of ions produced by X-rays in a flat ionization chamber filled with the liquid under investigation. The velocity of the ions is determined from a measurement of the difference in the times of arrival at the ions at the respective electrodes for two different initial positions of the ionized layer. The measured values of the mobility of the positive and negative ions in hexane are 4.1×10^{-4} and 1.3×10^{-3} $\mathrm{cm^2\,V^{-1}\,sec^{-1}}$, respectively.

532.7 : 537.2

14655 **DIELECTRIC CONSTANT OF LIQUID OZONE AND LIQUID OZONE—OXYGEN MIXTURES.**

C.K.Hersh, G.M.Platz and R.J.Swehla.

J. phys. Chem., Vol. 63, No. 11, 1968-9 (Nov., 1959).

This study was based on some preliminary measurements that showed the dielectric constants of liquid ozone and liquid oxygen at 90° K to be 4.75 and 1.46 respectively. The data presented include the dielectric constants of liquid ozone—oxygen mixtures containing 0 to 29.8 wt. % ozone at 90° K and of pure liquid ozone from 90 to 185° K.

532.7 : 537.2

14656 **THE RELAXATION TIMES OF POLYETHYLENE GLYCOLS.** M.Davies, G.Williams and G.D.Loveluck.

Z. Elektrochem., Vol. 64, No. 5, 575-80 (1960).

The dielectric properties (ϵ' and ϵ'') of a series of polyethylene glycols (M = 200 to 29 000) were measured for the liquids and for solutions in benzene over a range of frequencies up to 8.5×10^9 c/s (λ = 3.4 cm.). The relaxation times are strikingly independent of the concentrations and molecular weights, the solution values varying only by a factor of two, the mean value ($\tau = 10 \times 10^{-12}$ sec) corresponding to an effective size of the reorienting segment of little more than that of the monomer. Activation energies and entropies are deduced which correspond to a very simple flexible structure. Some evidence is adduced for a proportionality between τ (observed) and ϵ_0, i.e. for an empirical "internal field" correction factor applicable to the observed relaxation times. The dielectric relaxations of some highly viscous aqueous solutions were also examined.

532.7

14657 VISCOSITY AND LIGHT SCATTERING OF SOLUTIONS OF POLYACENAPHTHENE. N.Vene and G.Mohorčič.
"J.Stefan" Inst. Rep., Vol. 5, 71-9 (Oct., 1958). In German,

Measurement of the viscosity and light scattering of solutions of polyacenaphthene has shown a similar behaviour to linear polymers with aromatic side chains of the polystyrene type. The polyacenaphthene was prepared by three different methods of polymerization from carefully purified monomer. The polymer material was split into 10 fractions. For the parameter ϕ, in the relationship $[\eta] = \phi R^3/M_W$, which is for all flexible linear polymers a constant independent of temperature and solvent, a value of 2.0×10^{23} was found. R.Schnurmann

532.7

14658 TEMPERATURE DEPENDENCE OF THE REFRACTIVE INDEX INCREMENT OF POLYSTYRENE IN SOLUTION.
J.H.O'Mara and D.McIntyre.
J. phys. Chem., Vol. 63, No. 9, 1435-7 (Sept., 1959).

The refractive index increments of polystyrene in cyclohexane and in toluene were determined interferometrically as a function of temperature. The experimental results were found to be in good agreement with calculations based on the Gladstone–Dale rule when the liquidus state curves for the refractive index and specific volume of polystyrene are extrapolated below the glass transition and then used to calculate the refractive index increment for temperatures below this transition.

532.7 : 535

14659 ON THE THEORY OF CRITICAL FLUCTUATIONS. A.Munster.
J. Chim. phys., Vol. 57, No. 6, 492-9 (June, 1960). In French.

The theory is developed from statistical mechanical principles with the help of a semi-fine (cf. D.Massignon, Mécanique statistique des fluides, Paris, 1957) correlation function. A wave representation gives the same results if detailed molecular structure is obscured by suppressing the very short wave part of the fluctuation spectrum. The results of Ornstein and Zernike's theory (various papers in 1914-26) are recovered and a first approximation solution of their integral equation obtained which satisfies certain limiting conditions. The relation of the theory to that of Debye (Abstr. 12073 of 1959) is discussed. The validity of an essential result of Debye's theory is shown to be connected with that of Van der Waals' equation of state. The theory is applied to the phenomenon of critical opalescence and it is shown that the diffusion of visible light enables the semi-fine correlation function to be obtained at once. G.A.Chisnall

532.7 : 535.33 : 539.2

RAMAN SPECTRUM OF $SbBr_3$ IN THE LIQUID PHASE AND IN CS_2 AND CCl_4 SOLUTION. See Abstr. 13688

532.7 : 535.33 : 539.2

ABSORPTION SPECTRA OF SOLUTIONS OF Fe, Ni AND Cu MONO-, DI- AND TRI-ETHANOLAMINE COMPLEXES.
See Abstr. 13693

532.7 : 535.37 : 539.1.07

14660 THE α/β RATIO OF A LIQUID SCINTILLATOR. Yu.A.Nemilov, G.N.Belozerskii and A.N.Pisarevskii.
Optika i Spektrosk., Vol. 8, No. 4, 554-5 (April, 1960). In Russian.

The α/β ratio is the ratio of the scintillation yields of α- and β-particles. It was found that on addition of naphthalene to a solution of 2,5-diphenyloxazole (PPO) in toluene the α- and β-yields rose, the ratio α/β became greater and the region of the PPO concentration in which variations of α/β could be observed was extended to 5 g/litre. Some results are also reported on the α/β ratio and the scintillation yields of PPO and 4-di-[2-(5-phenyloxazolyl)]-benzene (POPOP) in toluene, of PPO and POPOP in polystyrene gels, and of stilbene crystals. A.Tybulewicz

532.7 : 535.37

14661 DETERMINATION OF THE TRUE DEGREE OF POLARIZATION OF FLUORESCENCE FROM SOLUTIONS. A.Budó, I.Ketskeméty, E.Salkovits and L.Gargya.
Acta phys. Hungar., Vol. 8, No. 1-2, 181-93 (1957). In German.

When secondary fluorescence occurs in the solution the measured polarization will differ from the true polarization for one stage only of fluorescence. A formula is obtained for the case when tertiary and higher stages are negligible. It was experimentally verified for solutions of fluorescein in glycerol. W.T.Welford

532.7 : 535.3

14662 THE DEPENDENCE OF SOLVENT–SOLUTE ENERGY TRANSFER IN LIQUID ORGANIC SOLUTIONS ON EXCITATION WAVELENGTH. S.G.Cohen and A.Weinreb.
Proc. Phys. Soc., Vol. 75, Pt 4, 623-5 (April, 1960).

Reference is made to previous critical discussions of energy transfer for p-terphenyl in xylene (Abstr. 7198 of 1956; 4888 of 1958). The original conclusion of the present authors that transfer efficiency is independent of excitation wavelength is substantiated b the more detailed results not previously published. G.F.J.Garlic

532.7 : 538.2

14663 ON THE INFLUENCE OF DISSOLVED OXYGEN ON TH LINE WIDTH OF ELECTRON SPIN RESONANCE IN SOLUTION. K.H.Hausser.
Naturwissenschaften, Vol. 47, No. 11, 251 (1960). In German.

The removal of atmospheric oxygen from solutions of Wurster' blue perchlorate increases the resolution of the hyperfine structur of the electron spin resonance absorption spectrum to a marked extent. The theoretical number of lines for interaction with the protons and the two nitrogen nuclei is observed in the central region o the spectrum. J.G.Powle

532.7 : 538.2

14664 NUCLEAR SPIN–LATTICE RELAXATION IN SOLUTIO R.W.Mitchell and M.Eisner.
J. chem. Phys., Vol. 33, No. 1, 86-91 (July, 1960).

T_1 for protons in C_6H_5Cl, C_6H_6, and C_6H_{12} was measured as a function of concentration in solution with CS_2 and CCl_4. T_1 does not have the dependence on the solution viscosity suggested by the theo of Debye. The rotational relaxation times at infinite dilution are obtained by extrapolation, and the correlation times calculated fron these results are compared with the values predicted by the rotating sphere model as well as an inner viscosity and microviscosity model. The inner viscosity model provides the best agreement wit the experimental results. The correlation times are found not to b proportional to the volumes of the molecules but seem to be simply related to the moments of inertia as well as the masses of the molecules of interest and the masses of the solvent molecules. An approximate formula which provides good results for the systems above is suggested as $\tau = 2I\eta a/\mu kT$, where I is the moment of inertia of the molecule of interest, η is the solvent viscosity, a is the average radius of the molecule, and μ is the reduced mass of the solvent–solute system.

532.7 : 538.27 : 539.21

14665 NUCLEAR MAGNETIC RESONANCE IN ALKALI ALLOY SYSTEMS, NaK AND NaRb. L.Rimai and N.Bloembergen.
J. Phys. Chem. Solids, Vol. 13, No. 3-4, 257-70 (June, 1960).

The Knight shift K in liquid Na–K and Na–Rb systems is a linear function of the relative Na-concentration 1–C. The relative variation $K^{-1}(\partial K/\partial C) = 0.361$ for Na^{23} in NaK, = 0.518 for Na^{23} in NaRb and = 0.270 for Rb^{87} in NaRb. An interpretation in terms of the scattering theory of conduction electrons is given. The line width of the Na^{23} and Rb^{87} resonances is a non-linear function of C. It is about a factor 5 larger in the Rb-rich alloys than at the Na-ric end. This result can be explained by the electron-coupled spin exchange interaction between different nuclei. The remarkable fact that these spin–spin interactions do not average to a small value in the liquid metals necessitates the postulate of a long range characte for the electron-coupled interaction. The Knight shift and line width in solid terminal solutions have also been observed and compared with theory. The experiments show that nuclear magnetic resonanc is particularly well suited to determine phase diagrams of alkali alloy systems.

532.7 : 538.2

14666 A COMPARISON OF THE MAGNETIC INTERACTIONS OF PROTONS AND DEUTERONS.
G.Laukien and F.Noack.
Z. Phys., Vol. 159, No. 3, 311-32 (1960). In German.

A comparison, using spin echo techniques, of the longitudinal (T_1) and transverse (T_2) relaxation times for the nuclear magnetic resonance of protons in solutions of paramagnetic ions in water and for deuterons in similar solutions in heavy water. It is found that for constant field when $T_{1P} \cong T_{2P}$ that $T_{1D} \cong T_{2D}$ and $T_D \cong 40\ T_P$ in accordance with the usual dipole–dipole theory. In some cases $T_2 < T_1$ and then an exchange interaction is invoked and discussed. J.G.Powle

532.7 : 538.27

14667 MOLECULAR MOTION IN LIQUID n-OCTYL BROMIDE BY PROTON MAGNETIC RESONANCE.

.G.Powles and A.Hartland.
roc. Phys. Soc., Vol. 75, Pt 4, 617-20 (April, 1960).

The proton spin—lattice relaxation time (T_1) in n-octyl bromide as measured in the temperature range −77° to 127° C at 21.5 Mc/s y the pulse method. The results, together with those from dielectric ieasurements, indicate a similarity of motion between that of the —Br bond and the remainder of the molecule, and this is conrasted with the case of n-octyl alcohol where only an attenuated art of the chain motion appears to be transmitted to the OH dipole. J.G.Powles

MECHANICS OF GASES

533.2 : 551.5

14668 AN AUTOMATIC DEW-POINT HYGROMETER USING PELTIER COOLING.

Gerthsen, J.A.A.Gilsing and M. van Tol.
hilips tech. Rev., Vol. 21, No. 7, 196-200 (1959-60).

The necessary cooling is produced by the Peltier effect of a ertain combination of semiconductors.

533.4

14669 APPARATUS FOR THE MEASUREMENT OF VAPOUR PRESSURE. G.Milazzo.

.C. Ist. Super. Sanita, Vol. 23, Pt 1, 32-8 (1960). In Italian.

Gives a description of a complete equipment to cover the ressure range 10^{-3} to 760 mm of Hg and the temperature range 100° C to 20° C. Five manometers (a mercury U-tube, two aneroids, McLeod gauge and a capacitance micromanometer) are incorporated nd two different manometers can be used for each pressure. Final urification and degassing of the specimen under vacuum can be perormed in the apparatus. J.M.Hough

533.6

14670 INFLUENCE OF PRESSURE HISTORY ON MOMENTUM TRANSFER IN RAREFIED GAS FLOWS. F.C.Hurlbut.

hys. of Fluids, Vol. 3, No. 4, 541-4 (July-Aug., 1960).

The coefficient for tangential momentum transfer σ between the oundary and a flow of rarefied gas has been investigated by the roating cylinder technique. Systematic perturbation of the pressure istory of the active surfaces were made and correlated with oberved variation of σ. A high-pressure history is found to result in lowering of σ with time (order of days) from values in the range .9-1.0 to values approaching 0.6. A low-pressure history is found o result in constant values of σ in the range 0.9 to 1.0. The obervations were of the same character for all gases.

533.6 : 538.3

14671 BLUNT BODY VISCOUS LAYER WITH AND WITHOUT A MAGNETIC FIELD. H.Oguchi.

hys. of Fluids, Vol. 3, No. 4, 567-80 (July-Aug, 1960).

Presents the solution for the viscous flow in the shock layer bout the stagnation region of the sphere in hypersonic flow. The eynolds numbers considered are in a range too low to apply usual oundary layer theory within the shock layer, but are large enough hat the shock wave may be regarded as a discontinuous surface. his viscous layer problem has been studied previously by Probstein. Vith the assumption of constant density in the shock layer an analytic olution is applied to this problem both with and without an applied nagnetic field. This solution makes use of the fact that the ratio of he density ahead of the shock to that behind the shock (ϵ) is small. he solution has been found in analytic form to first order in ϵ. In he nonmagnetic case numerical results for both the shock wave letachment distance and skin friction are presented for a value of $\epsilon = 0.1$ and they are shown to be in good agreement with the exact umerical calculations of Probstein and Kemp. Numerical results re also presented on the effect of an applied magnetic field on both he shock wave detachment distance and skin friction. It is found hat for a fixed value of ϵ and Reynolds number the skin friction lecreases and the detachment distance increases for increasing alues of the magnetic field parameter S which is proportional to he magnetic pressure divided by the total pressure.

533.6

14672 BOUNDARY-LAYER RESEARCH IN FLUIDS. G.E.Gadd.

Nature (London), Vol. 186, 1022-4 (June 25, 1960).

Report of a meeting held in London during April, 1960, arranged by Dr.W.P.Jones of the Aerodynamics Division, N.P.L. on behalf of the N.A.T.O. Advisory Group for Aeronautical Research. About forty papers were presented by authors from N.A.T.O. countries. The topics were grouped under the following headings: (1) effects of roughness on boundary-layer stability; (2) boundary-layer control; (3) stability of shear surfaces; (4) mechanism of transition and boundary-layer stability; (5) three-dimensional boundary layers; (6) turbulent boundary layers; (7) heat transfer.

533.6

14673 THE NUMERICAL INTEGRATION OF EQUATIONS FOR A LAMINAR BOUNDARY LAYER. I.V.Petukhov.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 307-10 (May 11, 1960). In Russian.

Considers a boundary layer on a body in an incompressible gas, and develops an asymptotic expansion for the velocity distribution in that part of the layer where it is independent of the boundary conditions on the surface of the body, and suggests a numerical procedure of integration. J.K.Skwirzynski

533.6 : 541.12

14674 TEMPERATURE OF A PLANE LAMINA AROUND WHICH FLOWS A REACTING GASEOUS MIXTURE.

E.P.Vaulin.
Zh. tekh. Fiz., Vol. 27, No. 7, 1503-9 (July, 1957). In Russian.

The problem is analysed of the temperature of such a lamina around which flows a steady-state laminar gas flow in which a non-isothermic reaction of the type $N_2 = 2N$ takes place. The problem is reduced to the solution of the equations of the boundary layer (equations of (1) diffusion, (2) continuity, (3) conservation of momentum, and (4) conservation of energy). Making use of some simplifying assumptions, the problem is solved of the steady-state temperature of the lamina for the case of a heterogeneous chemical reaction taking place in the diffusion region. F.Lachman

533.6

14675 NEARLY FREE MOLECULAR FLOW THROUGH AN ORIFICE. R.Narasimha.

Phys. of Fluids, Vol. 3, No. 3, 476-7 (May-June, 1960).

An approximate theoretical treatment is given of flow through an orifice at low Knudsen numbers. An expression is obtained for mass flow, and compared with experimental results for argon (Liepmann 1960). The agreement is reasonable but the experimental and theoretical accuracy is not great enough for refined comparisons to be made. R.F.S.Hearmon

533.6

14676 ON UNSTEADY GAS FLOWS IN LAVAL NOZZLES. O.S.Ryzhov and G.M.Shefter.

Dokl. Akad. Nauk SSSR, Vol. 128, No. 3, 485-7 (Sept. 21, 1959). In Russian. English translation in: Soviet Physics—Doklady, Vol. 4, No. 5, 939-42 (March-April, 1960).

Unsteady, nearly sonic flows, changing rapidly with time, are described by the wave equations of acoustics; oscillations of a thin profile under the conditions of such a regime were studied by Gardner and Ludloff [Journal of the Aeronautical Sciences, Vol. 17, No. 1, 47 (1950)]. If the change of the parameters of a nearly sonic flow occurs more slowly, but the character of the motion remains essentially unsteady, the same nonlinear term should be retained in the equation for the velocity potential, as in the usual theory of steady flows. In the present paper, an exact solution of the nonlinear equations is constructed, which is a general solution, pertaining to steady flows of a gas in the vicinity of the transition surface in Laval nozzles.

533.6

14677 THE VELOCITY-DEFECT LAWS OF THE TURBULENT BOUNDARY-LAYER. A.Kieda.

Doshisha engng Rev., Vol. 10, No. 1, 29-42 (June, 1959).

533.6

14678 AN ESTIMATE OF THE INFLUENCE OF FREE CONVECTION UPON TURBULENT FLOW. E.I.Yantovskii.

Zh. tekh. Fiz., Vol. 29, No. 11, 1390-2 (Nov., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 11, 1280-2 (May, 1960).

The flow in a flat vertical channel of definite width and the relative magnitudes of the terms in the equation of motion are considered. It is shown that the influence of free convection on laminar flow is large, but negligibly small on flow in the gravitational field.

S.Weintroub

533.6

14679

ON HYPERSONIC WAKES IN THE ATMOSPHERE. S.Feldman.

Phys. of Fluids, Vol. 3, No. 3, 479-80 (May-June, 1960).

The trails left in the atmosphere by a blunt non-ablating body moving at hypersonic velocities are dealt with by considering the cooling of an axisymmetric column of gas with variable properties. The appropriate differential equation is derived and integrated approximately to give density and temperature profiles corresponding to a flight velocity of 20 000 ft/sec at a height of 100 000 ft.

R.F.S.Hearmon

533.6

14680

APPARATUS FOR THE MEASUREMENT OF GAS VELOCITY IN FURNACES AND MODELS. A.E.Pengelly.

J. sci. Instrum., Vol. 37, No. 9, 339-46 (Sept., 1960).

A range of pitot tubes is described together with an electromagnetic transducer micromanometer. The assembly is designed for the measurement of gas velocity over a large range of temperature, and pollution with velocities as low as 40 cm/s. Some applications are described.

GASEOUS STATE

533.7

14681

THEORY OF GASES. XXV. CALCULATION OF THE COEFFICIENTS OF THE LAW OF MASS ACTION.

J.Duclaux.

J. Chim. phys., Vol. 57, No. 5, 374-80 (May, 1960). In French.

For previous work, see Abstr. 6834 of 1960. The theory of compressibility, based on progressive condensation, describes the formation of bigger and bigger groups of molecules under the influence of pressure. The number of groups is fixed by the law, which involves an infinite number of constants. These are obtained empirically and depend on temperature and the number of molecules in the groups. The compressibility of nitrogen is adequately represented by four constants. The theory is an extension of the theory of critical opalescence, and leads to a definition of corresponding states which does not involve the critical point.

P.Gray

533.7

14682

MEASUREMENT OF SMALL DIFFERENCES IN THE SECOND VIRIAL COEFFICIENT OF GASES AT TEMPERATURE BELOW 0° C. G.Thomaes and R.Van Steenwinkel.

Rev. sci. Instrum., Vol. 31, No. 8, 825-7 (Aug., 1960).

In order to get information about the differences in the intermolecular forces between isotopic globular molecules such as CH_4, CD_4, $C^{13}H_4$, etc., an apparatus to measure small differences between the virial coefficients of isotopic gases at low temperatures (70° to 300° K) has been designed. Theoretical considerations show that these differences should be very small (about 2% of the second virial coefficient itself for CH_4/CD_4 at 100° K), except at very low temperature. The scheme of the apparatus is described.

533.7

14683

VAPOUR PRESSURE OF ISOTOPIC LIQUIDS. II. Ne AND A ABOVE BOILING-POINT.

G.Boato, G.Casanova and M.E.Vallauri.

Nuovo Cimento, Vol. 16, No. 3, 505-19 (May 1, 1960).

For Pt I, see Abstr. 2168 of 1960. In order to extend previous studies of vapour pressure of isotopic liquids in a wider temperature range, a new cryostat was built. The single stage separation factor α of the isotopic pairs $A^{36}—A^{40}$ and $Ne^{20}—Ne^{22}$ was measured up to a vapour pressure of 12 atm, using natural isotopic mixtures. The logarithm of the vapour pressure ratio of the pure isotopes was derived from α and found to be linearly dependent on 1/T within the experimental error, which amounts to less than 2‰ at boiling temperature of neon. The dependence on 1/T is given numerically by $\ln (p_{36}/p_{40}) = 1.31(1/T) - 8.95 \times 10^{-3}$ for argon, from 83° K to 120° K, and by $\ln (p_{20}/p_{22}) = 2.510(1/T) - 5.673 \times 10^{-2}$ for neon, from 25° K to 40° K. A brief discussion of the results is given.

533.7 : 532

GAS—LIQUID PHASE EQUILIBRIUM BELOW 0° C IN THE SYSTEM $NH_3—N_2—H_2$ AND IN THE SYSTEM NH_3—Kr. See Abstr. 14639

533.7 : 536.

14684

DYNAMIC DETERMINATION OF THE THERMAL CONDUCTIVITY OF CARBON DIOXIDE AT DIFFERE TEMPERATURES. J.Robin, P.Dewasnes and C.Mabboux.

C.R.Acad. Sci. (Paris), Vol. 250, No. 18, 3003-5 (May 2, 1960). In French.

The cell described consists of a steel block with two similar cylindrical channels of 3.5 mm bore, having entry and exit holes f the passage of gases through the channels. Along the axis of eac channel there is a coaxial tube of 2.2 mm external diameter and 0.1 mm thickness which is open to the atmosphere and into which inserted a glass tube containing three thermistors. The middle thermistor of 4000 ohms resistance operates on the negative part of its characteristic and acts as a heater, and the other two, each of 10^5 ohms resistance, operate on the positive parts of their characteristics and measure the temperature. The block is thermostatted and its temperature measured by a platinum resist thermometer. The relative conductivities of commercial N_2, A an CO_2 were measured at temperatures between 40 and 180° C, and fo flows of 4.0 to 4.7 gm hr^{-1}. Using the values 5.73 (1 + 0.0027 t) 10 and 3.85 (1 + 0.0031 t) 10^{-5} for the conductivities in c.g.s. units of N_2 and A respectively, 3.60 (1 + 0.0055 t) was obtained for the conductivity of CO_2.

S.Weintro

533

14685

SHEAR AND HEAT FLOW FOR MAXWELLIAN MOLECULES. S.Ziering.

Phys. of Fluids, Vol. 3, No. 4, 503-9 (July-Aug., 1960).

In previous studies treating the problems of linear shear and heat flow in parallel plate geometry, a half-range moment expansi of the distribution function was given for arbitrary values of the Knudsen number. The half-range collision integrals for Maxwelli molecules are now evaluated numerically. The inverse fifth law o molecular interaction can be regarded as a lower bound for neutra gases. The problems of shear and heat flow are reconsidered in this light.

53

14686

ON THE MOLECULAR FLOW OF GASES THROUGH A POROUS PARTITION. S.P.Bakanov.

Zh. tekh. Fiz., Vol. 27, No. 7, 1619-21 (July, 1957). In Russian.

The need for establishing more exactly the applicability of the method and apparatus for the determination of the specific surface of porous and free-flowing solid substances [Deryagin, Krylova ar Fridlyand, Dokl. Akad. Nauk SSSR, Vol. 61, 653 (1948); Zhurnal Fizicheskoi Khimii, Vol. 24, No. 11, 1371 (1950)], based on the theory of the molecular gas flow through a porous medium [Derya Dokl. Akad. Nauk SSSR, Vol. 53, 627 (1946)], made it necessary to examine the gas flow at pressures at which the purely molecular (Knudsen) flow disappears. Formulae are derived for the gas flow rate and the coefficient of gas filtration through a porous partition

F.Lachm

533.

14687

REDETERMINATION OF THE INTERMOLECULAR POTENTIAL FOR KRYPTON. E.A.Mason.

J. chem. Phys., Vol. 32, No. 6, 1832-6 (June, 1960).

The intermolecular potential for krypton has been redetermin from transport property data, including new experimental results on thermal diffusion and thermal conductivity. Both the Lennard-Jones (12-6) and exp-6 potential functions have been used and reproduce the data about equally well. The parameter α of the exp-potential is not uniquely determined by the data, but a tentative selection of $\alpha = 13.5$ has been made semiempirically on the basis of the theory of the dispersion energy and the consistency with the other rare-gas potentials. The most important conclusion is that there is a large discrepancy, not found for the other rare gases, between the present results and the experimental crystal properti and second virial coefficient. No amount of parameter adjustment has been able to reduce the discrepancy to a reasonably acceptabl value. Possible explanations and implications of this unusual and unsatisfactory situation are discussed.

533.7 : 530

TRANSPORT IN DILUTE GASES AND CHEMICAL FORCES. See Abstr. 14547

533.7

14688 INTERMOLECULAR FORCES FROM DIFFUSION AND THERMAL DIFFUSION MEASUREMENTS.

eissman, S.C.Saxena and E.A.Mason.
rs. of Fluids, Vol. 3, No. 4, 510-18 (July-Aug., 1960).

Experimental values of the diffusion coefficient and the thermal usion factor for the systems He—A, He—CO_2 and H_2—CO_2, over emperature range of about −78° to 325° C, were analysed for the pose of testing the Lennard-Jones (12-6) and the exp-6 inter- lecular potentials, as well as the combination rules usually used conjunction with these potentials. The exp-6 potential gives excel- t results for He—A, but the 12-6 potential is not satisfactory. is system affords no opportunity to choose between the various nbination rules. The 12-6 potential works fairly well for He—CO_2 H_2—CO_2. On the whole, the combination rules are surprisingly od, being no worse than the potentials themselves. The importance considering the higher theoretical approximations for the thermal fusion factor is emphasized. An expression interrelating the nsport properties and independent of any particular intermolecular ential is proposed, which can be used to test how well a mixture nforms to the basic assumptions of the Chapman—Enskog theory to indicate the consistency of the experimental measurements.

533.7

14689 THERMAL-DIFFUSION-COLUMN SHAPE FACTORS FOR THE LENNARD-JONES (12-6) POTENTIAL.

B.McInteer and M.J.Reisfeld.
chem. Phys., Vol. 33, No. 2, 570-3 (Aug., 1960).

The theory of the hot-wire thermal-diffusion column as veloped by Jones and Furry (1946) involves the shape factors h, , and k_d, which are functions of the transport properties of the s. The shape factors have been evaluated numerically for a gas ose molecules interact according to the Lennard-Jones (12-6) tential, given by $V(r) = 4\epsilon[(\sigma/r)^{12} - (\sigma/r)^6]$. The results are tabu- ted for a range of kT/ϵ from 0.8 to 30 for temperature ratios as eat as 6 and for ratios of column radii up to 100. These values e more accurate than those previously computed for potentials rying as r^{-5} (Maxwellian) and for $r^{-\infty}$ (rigid spheres). The values r the constants are found to give good agreement with experi- ental data on the system He^3—He^4.

533.7 : 539.18

14690 THERMAL DIFFUSION OF TERNARY MIXTURES.

A.E.de Vries and M.F.Laranjeira.
chem. Phys., Vol. 32, No. 6, 1714-16 (June, 1960).

Experiments have been performed on ternary mixtures, con- isting of two isotopes and a nonisotopic compound. It is found that e influence of the third compound on the separation of the isotopes annot always be foreseen, the hardness (R_T value) being of extreme nportance.

533.7

14691 THE TEMPERATURE DEPENDENCE OF INTER-DIFFUSION COEFFICIENT FOR SOME PAIRS OF ARE GASES.

K.P.Srivastava and A.K.Barua.
dian J. Phys., Vol. 33, No. 5, 229-40 (May, 1959).

The inter-diffusion coefficients for the three gas pairs He—Ne, e—Kr and Ne—Xe have been determined at 0°, 15°, 30° and 45° C. he diffusion takes place between two bulbs separated by a pre- ision capillary tube. Samples of the gas are withdrawn from one ulb at different intervals of time and analysed by a differential onductivity analyser. These experimentally determined diffusion oefficients have been utilized for calculating the unlike potential arameters ϵ_{12} and σ_{12} on the Lennard-Jones (12 : 6) model and ompared with the values determined from the usual combination ules. The agreement is found to be satisfactory. The experi- nentally determined values of ϵ_{12} and σ_{12} reproduce the experimental ata on inter-diffusion quite satisfactorily. By utilizing Kelvin's ethod, self-diffusion coefficients have been calculated from nter-diffusion coefficient data and the results have been compared ith the experimental data when they are available.

533.7

14692 GASEOUS DIFFUSION IN POROUS MEDIA. I. A NON-STEADY STATE METHOD.

J.A.Currie.
rit. J. appl. Phys., Vol. 11, No. 8, 314-17 (Aug., 1960).

Laboratory equipment, capable of modification for use on soils the field, was constructed to study diffusion in porous systems. simple katharometer employs the exposed element of a thermal illiammeter to measure the instantaneous composition of hydrogen- ir mixtures; the most convenient working condition is when 15 mW are dissipated in the hot wire, at which the thermocouple output changes from 0.5 mV in pure hydrogen to 2.5 mV in air. The geometry of the experimental system is simple enough to permit a standard solution of the non-steady state equation for interdiffusion of two gases to be applied, and, as a check on performance, straight tubes of slightly varying geometry were used to measure the diffusion coefficient of hydrogen into air, and its dependence on temperature. Reproducibility was very good and, within the limits of experimental error, the coefficient obtained was the same for 100% hydrogen into 100% air, and 60% air +40% hydrogen into 100% air. Measurements at 12, 20, 28 and 36°C, fitted $D = D_0(T/273)^n$, with $D_0 = 0.651\ cm^2\ sec^{-1}$ at n.t.p., n = 1.715. Standard values are D_0 = 0.611 (International Critical Tables, 0.634 and 0.661 (Smithsonian Physical Tables). The latter reference gives n = 1.75.

533.7

14693 GASEOUS DIFFUSION IN POROUS MEDIA. II. DRY GRANULAR MATERIALS.

J.A.Currie.
Brit. J. appl. Phys., Vol. 11, No. 8, 318-24 (Aug., 1960).

The diffusion of hydrogen through cylindrical samples of porous granular materials, 3 in. long and 2. in. diameter, was measured by the non-steady state technique described in preceding abstract, and reduced coefficients of diffusion D, referred to the value D_0 in free air, were calculated for over twenty materials with porosity ϵ between 0.18 and 0.98. Results are comparable with those obtained by other methods, and with those for analgous electrical properties of porous media. Replicate determinations on a given sample agree to within 1%, but larger differences, caused by variations in packing, are observed between duplicate samples of the same porosity. It is shown theoretically that $D/D_0 = (l/l_e)^2 f\epsilon$, where f and l_e/l are factors for non-uniformity of cross-section and the increased length of the tortuous path followed by the gas, respectively. The influence on D/D_0 of not only porosity, but also particle shape, was clearly shown and there can therefore be no unique relationship for all materials, as often supposed, between diffusion rates and porosity. The equations of Burger and Bruggeman, both of which include a particle shape factor, were tested on the experimental data and neither was entirely satisfactory. An empirical equation of the form $D/D_0 = \gamma\epsilon^{\mu}$ fits all materials where $\gamma(\leq 1)$ and $\mu(\geq 1)$ are constant for a specific type of granular material, and probably represent measures of pore shape. Two particle shape parameters, relative surface area and equivalent settling radius, were measured for a limited number of materials, but at best, only a general trend between these and the experimental values for the Bruggeman shape factor was observed.

533.7 : 534.23

ABSORPTION OF SOUND IN ARGON, NITROGEN AND OXYGEN. See Abstr. 14739

533.7 : 534.23

14694 ULTRASONIC ABSORPTION AND DISPERSION IN POLYATOMIC GASES. THE SOURCES OF INTRAMOLECULAR IRREVERSIBILITY.

M.Huetz-Aubert and J.Huetz.
J. Phys. Radium, Vol. 20, No. 11, 860-75 (Nov., 1959). In French.

For earlier work, see Abstr. 4392 of 1959. The fundamental identity which exists between the perturbations due to radiation and those due to intramolecular relaxation which are inherent in some polyatomic gases is shown. Comparison of experimental and theoretical results is limited to diatomic gases.

533.7

14695 MULTIPLE VIBRATIONAL RELAXATION IN GASEOUS DIBROMOMETHANE.

N.J.Meyer.
J. chem. Phys., Vol. 33, No. 2, 487-92 (Aug., 1960).

Ultrasonic-dispersion and absorption measurements were made in gaseous dibromomethane at 296°K, and at pressures between 0.5 and 15 mm Hg. Wide-band transducers (solid dielectric microphone and driver) were used. A continuous selection of frequencies between 13 and 80 kc/s was used, generated as pulsed sine waves. Independent vibrational relaxation processes were found at 7.0 and 125 Mc/s atm^{-1}, with corresponding relaxation times of 3.02×10^{-8} and 0.146×10^{-8} sec. A third relaxation process was not within the experimental range of the apparatus, and occurs below 0.1 Mc/s atm^{-1} with a relaxation time longer than 1.8×10^{-6} sec. Seven of the nine vibrational modes have sufficient population at 296°K to contribute to the various relaxation processes. Primarily based upon the specific heat contributions of each mode, the assignments of the various modes relaxing at the different relaxation times were made.

533.7

14696 DIELECTRIC DISPERSION IN GASES AT 400 MEGACYCLES. J.E.Boggs and A.P.Deam.

J. phys. Chem., Vol. 64, No. 2, 248-50 (Feb., 1960).

An apparatus has been constructed for measuring the dielectric constant of gases as a function of pressure at 402.1 Mc/s. Measurements have been made on CH_3Cl, CH_3Br, C_2H_5Cl and $CHCl_2F$ at 40°. In all cases the dispersion was of the non-resonant type and was adequately represented by the Cole—Cole dispersion curve. The measurements are correlated with previous work on microwave absorption and with dielectric constant measurements at 9400 Mc/s and at low frequency.

533.7 : 537.2 : 532.7

A NON-LINEAR THEORY OF PERMITTIVITY AND REFRACTIVITY OF DIELECTRIC GASES. See Abstr. 14652

533.7 : 535.32

14697 THE COMPLEX REFRACTIVE INDEX OF SOME AMINES AS A FUNCTION OF PRESSURE AT A WAVELENGTH OF 6 mm. F.W.Heineken and H.W.de Wijn.

Physica, Vol. 25, No. 11, 1222-4 (Nov., 1959).

The complex refractive index of dimethylamine, trimethylamine, monoethylamine and diethylamine has been measured at a wavelength of 6 mm at pressures up to 40 cm Hg. The absorption coefficient of $(CH_3)_2-NH$, $(C_2H_5)-NH_2$ and $(C_2H_5)_2-NH$ is found to be proportional to the pressure, whereas the absorption coefficient of $(CH_3)_3-N$ shows a quadratic pressure dependence. The ratio $(n'-1)/p$ of $(CH_3)_3-N$ versus pressure shows a small positive derivative at low pressures.

533.7 : 535.37

14698 TRIBOLUMINESCENCE IN A MERCURY BUBBLER. L.J.Schoen.

Canad. J. Phys., Vol. 38, No. 7, 967-70 (July, 1960).

Triboluminescence spectra were obtained for He, A and N_2 bubbled through a Hg column. He and A containing air as impurity gave bright emissions, the N_2 emission was weaker; all spectra contained N_2, OH and Hg lines. The luminescence was due to a discharge mechanism; energy could be transferred by metastable rare gas atoms. J.Franks

VACUUM PHYSICS

533.5

14699 SURFACE PHENOMENA AT ULTRA-HIGH VACUUM. I. THE PRODUCTION AND MEASUREMENT OF ULTRA-HIGH VACUUM BY ALPERT'S METHOD. K.Kawasaki and T.Sugita.

Bull. Electrotech. Lab. (Tokyo), Vol. 22, No. 4, 241-51 (April, 1958). In Japanese.

In the apparatus described, vacua up to 10^{-10} mm Hg are obtained. The purpose of the arrangement is to study the properties of clean surfaces.

533.5 : 621.385.6

14700 A MINIATURE TITANIUM PUMP. M.Warnecke and P.C.Moutou.

Vide, Vol. 15, 41-51 (Jan.-Feb., 1960). In French.

Describes, and gives the operating characteristics of, a miniature pump of absorbing capacity about 10 000 cm^3 mm Hg, with a speed ~2 litres/sec in the range of pressures from 10^{-5} to 10^{-7} mm Hg for a bombarding power of 26 W, designed for evacuating low-power microwave tubes. The use of a small amount of directly heated titanium getter (absorbing capacity ~1400 cm^3 mm Hg) with a miniature Bayard—Alpert gauge, for the final stages of evacuating such tubes is also briefly discussed. J.Dutton

533.5

14701 SIMPLE DETECTOR FOR SMALL LEAKS USING A THORIATED TUNGSTEN EMITTER WITH OXYGEN AS PROBE GAS. R.N.Bloomer and W.C.Brooks.

J. sci. Instrum., Vol. 37, No. 8, 306-7 (Aug., 1960).

The paper briefly describes the use of a thoriated tungsten diode as a leak detector in well-baked vacuum systems. Maximum sensitivity (better than 10^{-6} litre-microns/sec) occurs at a filament temperature of about 1900° K. Graphs are included showing typical results of gauge sensitivity with change of oxygen pressure at various temperatures. T.Mulvey

53

14702 MASS SPECTROMETER TESTS TIGHTNESS OF SEA J.L.Peters.

Electronics, Vol. 33, No. 14, 74-6 (April 1, 1960).

Describes a mass spectrometer type of leak detector in whic high sensitivity is obtained without the need for baking out or any special high-vacuum techniques. The normal ill-effects of high base pressure are reduced by three orders of magnitude by using two magnetic spectrometers in series with an accelerating electr field between them. The spectrometer is designed to use helium as the probe gas. T.Mul

53

14703 CUT-OFF FOR THE VACUUM MANIPULATION OF CHLORINE. M.Green and K.H.Maxwell.

J. sci. Instrum., Vol. 37, No. 8, 303-4 (Aug., 1960).

The cut-out operates by the flow of fused silver chloride into capillary. The seal can be inspected for leaks and, if unsatisfact remade. Reservoirs for silver chloride are provided on each sid of the capillary so that many operations are possible. The vapou pressure is low at room temperature and vacua of 10^{-8} torr can b obtained with VacIon pumps. A.H.W.B

VIBRATIONS · ACOUSTICS

534.

14704 RESPONSE OF A NONLINEAR STRING TO RANDOM EXCITATION. R.H.Lyon.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 953-60 (Aug., 1960).

The response of a perfectly flexible string with longitudinal deformation to random excitation is studied in some detail. The equations of motion are essentially those of Carrier (Abstr. 1253 of 1946). The modified mean-square response for the "elastic" string is discussed and it is shown that the mean square deflectio is diminished from the linear case. From a study of the fourth moments, it also appears that the shape of probability distribution of the transverse displacement are altered, the response to gauss noise being in general nongaussian.

534.

14705 CONTRIBUTION TO THE THEORY OF RADIAL EXTENSIONAL VIBRATIONS IN THIN DISKS. D.S.Moseley.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 991-5 (Aug., 1960).

The theory of the radial mode of isotropic disks of vanishing thickness is extended to the case of small thickness-to-diameter ratio. Resembling the Rayleigh and Pochhammer—Chree correcti to the longitudinal modes of a thin circular bar, the radial mode correction by Pochhammer—Chree method is shown to be

$$\{1 - \tfrac{1}{4}[R_i \nu h/(1 - \nu)2a]^2\},$$

where R_i are the roots of zero thickness disk theory, ν is Poisson ratio, and $h/2a$ is the thickness-to-diameter ratio. Test of this a of a radial mode correction by Rayleigh's energy method has been made with the aid of frequency measurements on weakly prepolari barium titanate ceramic disks whose $h/2a$ ratios ranged from 0.0276 to 0.1171.

534.

14706 EXPERIMENTAL INVESTIGATION ON THE FLEXURA NATURAL FREQUENCIES OF PRISMATIC BARS AS A FUNCTION OF THE THICKNESS/LENGTH RATIO. I.Barducci and G.Pisent.

Acustica, Vol. 7, No. 5, 288-92 (1957). In German.

Experimental results are compared with a mathematical theory developed by Thomson (Abstr. 4639 of 1939).

534.1

14707 VIBRATION ISOLATION OF A RIGID BODY ON RESILIENT SUPPORTS. G.J.Andrews.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 995-1001 (Aug., 1960).

The equations of motion of a rigid body supported by an arbitrary number of arbitrarily oriented and located resilient mounts with damping are developed with rigour. Their solution is given in a form suitable for high-speed electronic digital computer programming and includes prediction of natural frequencies, static

placements and load distribution to the mounts due to static
ding, and frequency response curves for a given isolation system.
nethod is given for transforming the inertial properties of a rigid
dy to a desired frame of reference.

534.13

14708 **EXPERIMENTAL INVESTIGATION OF THE NATURAL ELASTIC VIBRATIONS OF ISOTROPIC CIRCULAR
LINDERS.** P.D.Edmonds and E.Sittig.
ustica, Vol. 7, No. 5, 299-305 (1957). In German.
An apparatus is described with the aid of which it is possible
measure the elastic resonances of cylindrical rods in the range
m 1 to 120 kc/s with an accuracy of about 1 in 10^{-5}. Azimuthal,
dial and axial nodes can be recorded by their amplitudes on the
les of the rod and hence the resonance can be ascribed to the
ferent modes of vibration. Data for an aluminium cylinder
.0 × 4.9 cm) with respect to natural frequency, elastic constants
d dimensions are compared with those proper to an infinitely long
linder.

534.13

14709 **A NOTE ON THE TORSIONAL VIBRATION OF A CONICAL BAR WITH VARYING RIGIDITY AND
ENSITY.** A.K.Mitra.
Technol.(Calcutta), Vol. 4, No. 1, 37-9 (June, 1959).

534.13

14710 **EXPERIMENTAL STUDY OF THE VIBRATIONS OF A CIRCULAR CYLINDRICAL SHELL.** W.G.Gottenberg.
Acoust. Soc. Amer., Vol. 32, No. 8, 1002-6 (Aug., 1960).
An apparatus is described which permits the mode shape of a
brating circular cylindrical shell to be obtained quite easily.
hese measurements are made without contacting the cylinder and
an be converted to actual lineal values. A representative number
results obtained with such a system are shown to illustrate the
elationship between the nodal pattern and frequency in a cylinder
well as the effect of internal pressure on these frequencies.
inally, comparisons are made between these results and Timoshenko
eory and an appropriate shell theory.

534.13

14711 **AXIALLY SYMMETRIC VIBRATIONS OF A THICK CYLINDRICAL SHELL IN AN ACOUSTIC MEDIUM.**
.E.Greenspon.
. Acoust. Soc. Amer., Vol. 32, No. 8, 1017-25 (Aug., 1960).
Discusses the dynamic behaviour of infinitely long thick
ylindrical shells surrounded by water. The shell is excited by
xially symmetric forces. The solution is formed by coupling the
ree dimensional elastic solution with the expression for the fluid
ressure in cylindrical coordinates. Curves are presented which
ive the forced vibration amplitude and acoustic pressure in the
ater as a function of frequency for various modes of vibration of
e cylinder.

534.13

14712 **LARGE AMPLITUDE OSCILLATIONS OF A TUBE OF INCOMPRESSIBLE ELASTIC MATERIAL.** J.K.Knowles.
uart. appl. Math., Vol. 18, No. 1, 71-7 (April, 1960).
Axially symmetric free oscillations of a tube of incompressible
ighly-elastic solid, set in motion in the absence of surface
ressures, are possible for a wide class of strain-energy functions. A
eneral expression is obtained for the period of oscillation, and the
ases of a thin-walled tube and of a Mooney type of rubber receive
pecial consideration. J.G.Oldroyd

534.13 : 535.8

14713 **MODE OF VIBRATION OF DOUBLE-CONVEX QUARTZ LENSES OF AT-CUT CRYSTALS.**
.I.Yaroslavskii, P.G.Posniakov and I.G.Vasin.
ristallografiya, Vol. 3, No. 6, 763-4 (Nov.-Dec., 1958). In Russian.
nglish translation in: Soviet Physics—Crystallography (New York),
ol. 3, No. 6, 774-6 (Jan., 1960).
The appearance of Chladni's figures on a double-convex AT-cut
uartz lens with truncated edges is described. The figures indicate
hat the vibrations are produced by shear occurring in the direction
f the electrical axis of the crystal and that the fixing points for this
ype of lens should be at the opposite ends of the nodal line passing
long the Z axis of the crystal. H.J.H.Starks

534.13

14714 **A NOTE ON STRESS WAVES IN VISCO-ELASTIC ROD.** S.Datta.
J. Technol. (Calcutta), Vol. 4, No. 1, 41-6 (June, 1959).

The stress waves in thin viscoelastic rods of Maxwellian material have been calculated for cases when the rod is finite or semi-infinite. The boundary conditions chosen were: one end of the rod to be subjected to a prescribed velocity which continued for a finite time, the other end of the rod being free or fixed. The solution has been obtained with the help of a Laplace transformation.

534.2

14715 **STRESS-OPTICAL INVESTIGATIONS OF BENDING WAVES WITH EXPONENTIAL NEAR-FIELDS.** O.Weis.
Acustica, Vol. 7, No. 6, 402-8 (1957). In German.

The appearance of exponential near-fields within the limits of validity of elementary bending-wave theory is discussed, with reference to several examples. Certain relevant stress-optical observations are quoted.

534.2

14716 **THE PROPERTIES OF A LONGITUDINAL WAVE AT AN INTERFACE.** M.Peschel.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 221-6 (Jan., 1960). In German.

The equations governing the transition of a longitudinal wave in a solid elastic medium are derived for the cases where the wave enters (a) another solid elastic medium, (b) an ideal fluid, and (c) a vacuum. The corresponding electromechanical analogies are quoted. H.J.H.Starks

534.2

14717 **PROPAGATION OF ELASTIC WAVES IN AN INFINITE PLATE OF CYLINDRICALLY AELOTROPIC MATERIAL.**
M.Mitra.
Z. angew. Math. Phys., Vol. 10, No. 6, 579-83 (1959).

The oscillations of an infinite plate of cylindrical aelotropy are considered for motions symmetrical about an axis perpendicular to the plate. The frequency equations obtained were used to calculate numerically, for the first two modes of propagation only, the dependence of the wave-velocity on the wave-length of progressive waves in such plates.

534.2

14718 **SCATTERING OF IMPULSIVE ELASTIC WAVES BY A SMOOTH CONVEX CYLINDER.** F.Gilbert.
J. Acoust. Soc. Amer., Vol. 32, No. 7, 841-57 (July, 1960).

The canonical problem of scattering by a circular cylinder is expressed in integral form. The integrals are evaluated asymptotically to yield the first motion approximations. The geometrical theory of diffraction, developed by Keller, is combined with the first motion approximations to solve the problem of scattering by a smooth convex cylinder. The results are valid for pulses whose durations are short compared to the travel time across the cylinder.

534.2

14719 **AN APPROXIMATE SOLUTION TO THE ACOUSTIC RADIATION OF A FINITE CYLINDER.**
G.A.Brigham and M.F.Borg.
J. Acoust. Soc. Amer., Vol. 32, No. 8, 971-81 (Aug., 1960).

Utilizing the assumption of an omnidirectional point source and varying degrees of acoustical transparency associated with a finite cylindrical shell with rigid end caps, two separate approaches have been derived to the problem of far-field sound radiation emanating from a normal mode of vibration. In addition, a third approach is obtained by expanding the expressions of Laird and Cohen (Abstr. 2524 of 1952) and applying them to a shell-band source on an infinite cylinder. Several different environments are considered for each approach and for one of these environments, the results are compared to the experiment. The comparison of these theories indicates that for acoustic wavelengths considerably greater than structural wavelengths and dimensions, the assumption of omnidirectional point sources and acoustical transparency is reasonable even though the source is curved and "unbaffled". At higher frequencies, the pressure levels and directivity in the far field are approximately independent of the transparency or opaqueness of the source, thus indicating that an "equivalent" transparent cylinder of infinitesimal spherical sources could give, at most, only three or four dB cancellation effects when a single mode excitation basis is assumed.

534.21

14720 ACOUSTIC (0, 1) WAVE TRANSMISSION THROUGH THIN RECTANGULAR PLATES.

E.G.Eichler and R.F.Lambert.
Acustica, Vol. 7, No. 6, 379-86 (1957).

Transmission loss measurements of thin, rectangular aluminium plates employing the (0, 1) acoustic mode of a waveguide are described. Theoretical transmission loss formulae are derived for the limiting cases of small and large ratios of frequency to plate thickness. In the case of large ratios, a "mass law" formulation is obtained which exhibits an angular dependence characteristic of the (0, 1) mode. Complete sound transmission predicted for angles near grazing is verified by the experimental results for all plates studied. Some discrepancies between theory and experiment for small ratios are discussed and an attempt is made to correct the calculations empirically. The discrepancies between theory and experiment are here attributed to internal plate dissipation and imperfect boundary clamping.

534.21

14721 THE PROPAGATION OF SOUND IN MONATOMIC GAS MIXTURES.

R.Holmes and W.Tempest.
Proc. Phys. Soc., Vol. 75, Pt 6, 898-904 (June, 1960).

The velocity and absorption of infinitesimal plane sound waves were measured in neon—helium, argon—helium and krypton—helium mixtures, with molar fractions of helium from 0 to 1 in each mixture. The measurements were made at 25° C, at a frequency of 700 kc/s, and at pressures from 0.1 to 2 atm. The observed velocity of sound was correlated with values calculated from simple mixture thermodynamics; the measured absorption coefficients agreed with those calculated from a formula derived by Kohler.

534.21

14722 SOUND PROPAGATION IN PLATES AND RODS OF RUBBER-ELASTIC MATERIALS.

H.J.Naake and K.Tamm.
Acustica, Vol. 8, No. 2, 65-76 (1958).

The known results for the propagation of sound in plates with Poisson's constant $\sigma = 0.5$ (liquids) and $\sigma = 0.35$ (aluminium) are completed by dispersion curves with $\sigma = 0.47$ (rubber). The dispersion curves are easily interpreted because of the large difference between the velocities of transverse and longitudinal waves occuring at this value of σ. Measurements of the propagation of elastic waves in rods of rubber with square cross-section in the frequency range from 0.1 to 300 kc/s are reported. The amplitude is measured as a function of distance by partly submerging the rod into a water-filled vessel within which a hydrophone is arranged. The results with respect to phase velocity and attenuation can be explained in terms of the propagation of extensional waves at low frequencies and compressional waves at high frequencies, separated by a range with high attenuation.

534.21

14723 STRUCTURE-BORNE SOUND PROPAGATION IN BUILDING ELEMENTS MADE FROM HOMOGENEOUS AND HETEROGENEOUS BUILDING MATERIALS.

J.Rupprecht.
Acustica, Vol. 8, No. 1, 19-26 (1958). In German.

The propagation of structure-borne sound in homogeneous and heterogeneous rods of building materials was measured in the range from 100 to 10 000 c/s. The measurements were carried out under travelling-wave as well as standing-wave conditions, and it was found that, in accordance with theory, the heterogeneous building elements could be represented as low pass filters. Suggestions are made for the attenuation of structure-borne sound in building construction.

534.21

14724 A PROPERTY OF MULTI-TERMINAL ACOUSTICAL JUNCTIONS.

W.K.R.Lippert.
Acustica, Vol. 7, No. 4, 234-40 (1957).

The N-terminal acoustical junctions under discussion consist of a device with one input duct and N—1 non-reflecting output ducts, all of which have the same cross-sectional dimensions. A particular group of these junctions with the simplest possible impedance matrix is considered. A general phase relation between the characteristic reflection and transmission factors of waves travelling across such loss-free acoustical junctions is derived, and its usefulness is demonstrated experimentally for two cases in which $N = 3$. In practice the required conditions of symmetry can be fulfilled for values of $N = 2$, 3 and 4 but only approximately when $N > 4$. The method can be applied to certain 2 N-terminal electr circuits and transmission lines, where instances exist in which $N > 4$.

534

14725 ACOUSTIC PROPERTIES OF FLEXIBLE AND PORO MATERIALS.

C.W.Kosten and J.H.Janssen.
Acustica, Vol. 7, No. 6, 372-8 (1957).

The theory of Zwikker and Kosten for the propagation of soun waves in porous, flexible materials is extended by the introductio of known expressions for the complex density (Crandall) and bulk modulus (Kosten) of air in cylindrical pores. The complicated so tion of the differential equations for the case of a flexible layer o rigid wall is simplified and then discussed. Measurements corro rate the theoretical results. An increase of the sound absorption efficient in the low frequency region is the most pronounced effec of the flexibility of the medium.

534

14726 SHALLOW WATER UNDER-ICE ACOUSTICS IN BARROW STRAIT.

A.R.Milne.
J. Acoust. Soc. Amer., Vol. 32, No. 8, 1007-16 (Aug., 1960).

During April and May 1959, some underwater acoustic measu ments were made in Barrow Strait in the Canadian Arctic Archip The water in the experimental area was covered with 7 ft of youn shore-fast ice and depths ranged between 380 and 815 ft. Recordi of ambient noise were made at one location to include frequencies between 3 c/s and 10 kc/s. These exhibited several harmonically related spectrum lines and, in particular, a prominent line near 7 which appeared to have a wind-induced excitation. The frequencie of the spectrum lines are apparently related to a set of standing waves between the surface and the bottom of the water. No relati between the frequency of the air-coupled flexural wave in the ice (17.5 c/s) and the ambient noise spectrum was detected. The velocity of sound versus depth in the water had a mean positive gradient of 0.04 $\sec^{-1}$, caused primarily by a positive temperatur gradient. The velocity of sound versus depth in the sedimentary column, obtained by seismic refraction methods, can be expresse as $9025 - 4300 \exp(-z/300)$ ft/sec with z in feet. Additional work included a sound transmission run to a range of 10 nautical miles using explosive charges as sources. At distant ranges the transmission loss was essentially that to be expected from cylindrical spreading but exceeded this by 1 dB per nautical mile in the 9.6 t 19.0 kc/s band.

534.21 : 621.37

14727 VARIABLE ULTRASONIC WATER DELAY LINE.

G.W.Williams.
Brit. J. appl. Phys., Vol. 11, No. 8, 358-63 (Aug., 1960).

A variable delay line that uses ultrasonic propagation in wate has been constructed. The delay, variable from 200 to 2600 μs, i controlled by an input voltage, and is variable at a rate of 40 μs/ A bandwidth of 800 kc/s is achieved at the carrier frequency of 7 Mc/s. The delay is stable to better than 0.05% over the normal range of room temperatures. Automatic gain control holds the change in level of the output pulse to better than ±1 dB.

534.22 : 541.

14728 MEASUREMENT OF SOUND VELOCITY IN EXPLOSI PRODUCTS.

V.M.Zaitsev, P.F.Pokhil and K.K.Shvedov.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 155-7 (July 1, 1960).
In Russian.

The velocity of sound was measured by a method based on reflection of the explosive waves from a plate of inert material fixed to the end of the charge. The change in the sound velocity with time was measured and derived values of density and pressu in the explosion products were found for some TNT explosions.

R.F.S.Hearm

534

14729 STRESS WAVES IN SOLIDS.

C.R.Cassity.
J. appl. Phys., Vol. 31, No. 8, 1377-81 (Aug., 1960).

Several experimental tests dealing with the effects of stress waves initiated in solids by high explosives or by impacts are described. The tests indicate that stress waves which are initiated solely as compression commonly acquire tensile components whic are not due to reflections.

534.22

14730 PERIODIC SHOCK WAVES IN RESONATING GAS COLUMNS. R.A.Saenger and G.E.Hudson.

Acoust. Soc. Amer., Vol. 32, No. 8, 961-70 (Aug., 1960).

When an oscillating piston forces the enclosed gas in a Kundt e to vibrate with a finite amplitude near an acoustic resonance quency of the gas column, shock waves are generated which vel periodically back and forth in the tube. There is also heating he gas and a rise in its mean pressure. A theory of the steady te motion of the gas in its "fundamental" mode has been devised ich includes the dissipative effects of wall friction and heat con- tion to the tube walls. The dependence of shock strength, mean perature, and mean pressure on piston amplitude, tube length, viscosity, and heat conductivity predicted by the theory are in d qualitative agreement with the small number of experimental a available at present.

534.22

14731 ELECTRON DIFFUSION AHEAD OF SHOCK WAVES IN ARGON. H.D.Weymann.

ys. of Fluids, Vol. 3, No. 4, 545-8 (July-Aug., 1960).

Experiments with electrostatic and magnetic probes were per- rmed to investigate the electron diffusion ahead of shock waves M_s = 8 to 12 in argon. Negative electrostatic signals of several its were obtained with pronounced fronts propagating with velo- ies up to several times the shock velocity. The current produced the diffusing electrons was determined from a measurement of the imuthal magnetic field and found to be of the order of 10^{-5} amp for s = 12. By assuming that the electron flow velocity is approxi- ately equal to the velocity of the electrostatic front the measured rrent corresponds to an electron density of $n_e \approx 10^7$ cm^{-3} at about n ahead of the shock front.

534.22 : 535.33

14732 TEMPERATURE MEASUREMENTS OF SHOCK WAVES BY SPECTRUM-LINE REVERSAL. II. A OUBLE-BEAM METHOD. J.G.Clouston, A.G.Gaydon and I.R.Hurle.

roc. Roy. Soc. A, Vol. 252, 143-55 (Sept. 8, 1959).

For Pt I, see Abstr. 8744 of 1960. The sodium-line reversal ethod, as previously described, using a photomultiplier and oscillo- aph, has been modified. Two light beams are now employed, and terference filters are used in front of the photomultipliers instead a spectrograph. In one beam the background source is viewed rectly, through the shock tube, and in the other beam the background urce is viewed through the shock tube by a mirror system with a eutral filter interposed to reduce its effective brightness tempera- re. With a suitably chosen temperature for the background, one scillograph trace indicates absorption and the other indicates mission of the sodium lines. It is thus possible, from the records a single shock, to determine the temperature history behind the hock wave to about ± 20°C. Nitrogen and oxygen again show elaxation effects near the front. Temperatures in argon tend to come w, owing to radiative disequilibrium; excitation processes in argon re discussed. With this system it is possible to determine tempera- res rather higher than that of the background source. Some work as also been done, with a single-beam method, using a carbon arc s background and following reversal of the indium blue line. emperatures up to 3600° K have been measured in shocks through itrogen, but the time resolution is not so good.

534.22 : 541.12

A METHOD OF STUDYING AN EXPLOSION BY MEASURING HE PARAMETERS OF SHOCK WAVES. See Abstr. 14110

534.23

14733 SOURCES OF SOUND IN PIEZOELECTRIC CRYSTALS. E.H.Jacobsen.

Acoust. Soc. Amer., Vol. 32, No. 8, 949-53 (Aug., 1960).

The production of sound in piezoelectric crystals is examined rom the viewpoint of the inhomogeneous wave equation. It is shown hat sound is generated by a gradient in the piezoelectric stress and hat consequently the free surfaces of a piezoelectric crystal are sually the most effective wave sources. The excitation of sound at icrowave frequencies is also discussed and shown to be equivalent o the case of r.f. excitation at low frequencies.

534.23

14734 CALIBRATION OF UNDERWATER TRANSDUCERS BY THE FREE-FIELD RECIPROCITY METHOD. H.Mermoz.

Acustica, Vol. 8, No. 2, 103-11 (1958). In French.

The reciprocity method used in a free field can be used to calibrate linear underwater transducers at frequencies above 5 kc/s. The principle of this method is surveyed briefly, sources of error being indicated. A description is given of the installation and measurements carried out at the laboratory of the Marine Nationale (Brusc).

534.23 : 532.5

ACOUSTIC PRESSURE VARIATION AND THE SPECTRUM IN OSCILLATORY CAVITATION. See Abstr. 14597

534.23 : 532.5

CINEMATOGRAPHIC INVESTIGATIONS OF OSCILLATORY CAVITATION. See Abstr. 14598

534.23 : 532.5

OSCILLATORY CAVITATION WITH SHORT SONIC PULSES. See Abstr. 14599

534.23 : 538.56

14735 THE SIGNAL/NOISE PERFORMANCE OF ELECTRO-ACOUSTIC STRIP ARRAYS. D.G.Tucker.

Acustica, Vol. 8, No. 1, 53-62 (1958).

The directional patterns (or directivity curves) and the signal/noise performance of fourteen different arrangements of a strip array are discussed and tabulated. The fourteen arrangements include five used for the determination of the direction of a received signal by a null method. The noise concerned includes the thermal-agitation noise of the array, the noise generated in the receiving amplifiers, and to a large extent also noise arising in the medium of transmission. The noise factor used in these calculations is shown to be closely related to the directivity index (or power gain) in ordinary tapered arrays. The paper is written in terms of electro-acoustic arrays, but applies equally, in principle, to electromagnetic arrays.

534 23

14736 SIGNAL/NOISE PERFORMANCE OF SUPER-DIRECTIVE ARRAYS. D.G.Tucker.

Acustica, Vol. 8, No. 2, 112-16 (1958).

A super-directive array is defined as one whose effective aperture exceeds its physical aperture, and it is shown that while such an array has a directivity index somewhat better than that of an ordinary array, neverthless its noise factor is much worse. Consequently, in many receiving systems, the use of super-directivity is not be recommended. The conception of super-directivity is extended to bearing-determining arrays which give a null response on the axis, and it is shown that the same disadvantage of a bad noise factor applies to them also.

534.23

14737 A NOTE ON RECIPROCITY IN LINEAR PASSIVE ACOUSTICAL SYSTEMS. J.H.Janssen.

Acustica, Vol. 8, No. 2, 76-8 (1958).

It is shown theoretically that linear acoustical passive systems can behave as so called reciprocity-violating systems; an example of such a system is a sound absorbing material that is porous as well as flexible.

534.23 : 621.391

14738 THE RANDOMIZATION OF COMBINATIONS OF NOISE SOURCES BY MEANS OF DELAY LINES. D.G.Tucker.

Acustica, Vol. 7, No. 6, 399-402 (1957).

A discussion is given of the correlation between the outputs of the two ends of a delay line, or between the corresponding outputs of two different delay lines, when a number of narrow-band noise sources, identical except that their outputs are all uncorrelated, are connected to points uniformly distributed along the delay lines. It is shown that when the total phase-shift in a delay line has a suitable value (e.g. $\pm\pi$ radians if the number of sources is large), the outputs at the two ends are quite uncorrelated, and that if the differences between the total phase-shifts of two delay lines has a suitable value ($\pm\pi$ radians as before, if the number of sources is large, but not the same as before if the number is small), then the outputs of the two lines are uncorrelated. The application of these results to the calculation of the noise factor of acoustic strip arrays is also discussed.

534.23 : 533.7

14739 THE ABSORPTION OF SOUND IN ARGON, NITROGEN AND OXYGEN. W.Tempest and H.D.Parbrook.

Acustica, Vol. 7, No. 6, 354-62 (1957).

Some improved values for sound absorption in these gases in the frequency/pressure range 0.45 to 12.6 (Mc/s) atm are presented and compared with theoretical values.

534.23 : 533.7

ULTRASONIC ABSORPTION AND DISPERSION IN POLYATOMIC GASES. THE SOURCES OF INTRAMOLECULAR IRREVERSIBILITY. See Abstr. 14694

534.23 : 541.18

14740 EFFECT OF TRANSPORT PROCESSES ON ATTENUATION AND DISPERSION IN AEROSOLS. S.L.Soo.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 943-6 (Aug., 1960).

Dispersion and attenuation of sound waves (sonics and ultrasonics) in aerosols were studied. Effects of momentum and heat transfer between the solid particles and the gas were considered. Significance of relative acceleration of particles is demonstrated.

534.24

14741 REFRACTION AND TOTAL REFLECTION OF WAVES IN MEDIA IN MOTION. A.Metz.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3591-2 (May 30, 1960). In French.

The theory of the refraction and reflection of a plane acoustic wave when passing from one medium to another in which the wave velocity is different is discussed for the case when there is relative motion between the two media. H.J.H.Starks

534.24

14742 APPLICATIONS OF TOTAL REFLECTION IN MEDIA IN MOTION. A.Metz.

C.R. Acad. Sci. (Paris), Vol. 250, No. 24, 3955-7 (June 13, 1960). In French.

The practical significance of theoretical studies of the behaviour of acoustic waves passing from one medium to another moving relative to it (see preceding abstract) is illustrated by considering the audibility of an external sound source to an observer stationed near a small aperture in a room in which the air is calm. When the external air is moving with different velocities parallel to the wall containing the aperture, certain regions can be found in which the sound is inaudible to the observer. H.J.H.Starks

534.26

14743 EXPERIMENTAL EVIDENCE OF NONLINEAR RELATION BETWEEN SPECTRAL NUMBER AND ULTRASONIC INTENSITY. K.Samal.

Acustica, Vol. 7, No. 4, 251-2 (1957).

The relation between ultrasonic intensity and the number of diffraction spectra has been shown to be nonlinear for smaller numbers, which contradicts Sanders' suggestion (Abstr. 5220 of 1936). With the application of the relation, the ultrasonic absorption coefficients of C_6H_6, CS_2 and CCl_4 are measured. The expected values were obtained.

534.26 : 539.2

ULTRASONIC SCATTERING AND ATTENUATION IN POLYCRYSTALLINE COPPER AND α-BRASS. See Abstr. 13503

534.6

14744 A NEW LARGE REFLECTION-FREE ROOM FOR SOUND-WAVES. W.Kraak, G.Jahn and W.Fasold.

Hochfrequenztech. u. ElektAkust., Vol. 69, No. 1, 1-7 (Feb., 1960). In German.

A description is given of the design and construction of a large anechoic room at the Dresden Technische Hochschule. Acoustic tests of the room are described and experimental results are given over a range of frequencies from 60 c/s to 11 kc/s. A.B.Wood

534.6

14745 THE IMPROVEMENT OF OBJECTIVE AND SUBJECTIVE ACOUSTIC MEASURING TECHNIQUES BY THE USE OF F.M. BAND NOISE. H.Niese.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 193-202 (Jan., 1960). In German.

The principles involved in producing frequency-modulated band noise are described, circuits and oscillograms being shown in illustration. The application of this method to subjective and objective acoustic investigations is then discussed. In the measurement of reverberation time of rooms, a comparison is made between three methods; (a) octave analysis, (b) third-octave analysis, and (c) f.m. band noise (Δf = 40 and 100 c/s). Similarly, these three methods are compared in the measurement of sound absorption coefficients. The range of frequencies used in these measurements covered 100 c/s to 10 kc/s. A.B.Wood

534

14746 MAKING SONOGRAMS. D.Tamash.

Kristallografiya, Vol. 4, No. 2, 261 (March-April, 1959). In Russi English translation in: Soviet Physics—Crystallography (New York Vol. 4, No. 2, 241 (Feb., 1960).

A method is described for making fine-grained plates of unifo density for ultrasonograms. Details of the composition of the best emulsion are given. C.F.Barnal

534

14747 ANGULAR DEVIATION IN DIRECTIONAL RECEIVER CORRELATION. M.J.Jacobson and R.J.Talham.

J. Acoust. Soc. Amer., Vol. 32, No. 7, 810-20 (July, 1960).

When the axes of two directional pressure gradient receivers providing inputs to a steerable correlator receiving system deviat from the desired broadside direction, the system output is altere An analysis of the improvement in output signal-noise ratio shows that, in general, the maximum improvement decreases, the directi of maximum improvement shifts from broadside, and the range o source direction over which there is improvement decreases. Simplified expressions are given for these changes in the importan case of small deviation angles. The system output is then studied under the condition that the deviation angles are random variables and probability expressions are derived for the maximum improvement, the direction of maximum improvement, and the improveme at a given source direction. An example is included for the case o independent deviation angles having identical, even, uniform distributions.

534

14748 STATISTICAL DISTRIBUTION OF TIME INTERVALS. C.B.Sacerdote.

Acustica, Vol. 7, No. 6, 349-54 (1957).

The equipment described was used to establish automatically the statistical distribution of the time intervals during which the sound level of an acoustical phenomenon exceeds a prefixed level. Some results are reported that have been deduced from the examination of traffic noise and from the analysis of different voices.

534.

14749 ON THE THEORY OF THE RAYLEIGH-DISK AND THE SOUND PRESSURE RADIOMETER.

H.H.Jensen and K.Saermark.

Acustica, Vol. 8, No. 2, 79-86 (1958).

Expressions are derived for the mean torque $\bar{H}$ and the mean force $\bar{K}$ on a thin, rigid obstacle, placed in a plane, progressive sound wave of arbitrary wavelength. Numerical calculations are carried out for a long strip and a circular disk, in the latter case based upon earlier numerical results by Kotani, Bouwkamp and Kawai. It is found that, when the wavelength is varied, both $\bar{H}$ and $\bar{K}$ go through maxima and minima owing to resonance effects in the diffraction by the strip or disk.

534.6

14750 VIBRATION SENSITIVITY OF CONDENSER MICROPHONES. E.Rule, F.J.Suellentrop and T.A.Perls.

J. Acoust. Soc. Amer., Vol. 32, No. 7, 821-3 (July, 1960).

The problem of operating condenser microphones in a vibratio environment is considered, and it is pointed out that there is a precise relation between the vibration and pressure response for any given transducer. This relation is shown to be dependent on the mass per unit area of the microphone diaphragm, and graphs are given from which the suitability of a given microphone to perform its function in a vibration environment can be assessed. The result of measurements on a well-known type of condenser microphone are presented to support the theory, and the usefulness and disadvantages of vibration-isolating mounts and of systems using two transducers are discussed. A proposed design of a condenser microphone to be insensitive to vibration is described.

534.6

14751 HIGH-FREQUENCY CALIBRATION OF AN ADP CRYSTAL MICROPHONE.

P.A.Macpherson and D.B.Thrasher.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 1061-4 (Aug., 1960).

The free-field sensitivity of a microphone over the frequency range 10 000 to 100 000 c/s is determined by the reciprocity technique, in which the transducers are oriented perpendicular to each other in order to minimize diffraction effects. This orientation introduces a complication when the wavelength of sound is nparable to or smaller than the diameter of the microphone e. On theoretical grounds it is established that the sensitivity the microphone should fall to zero at a discrete set of frequencies. perimental minimum responses were observed that are in asonable agreement with the theory.

534.6 : 621.395.623.64

14752 SUGGESTION RELATIVE TO THE STANDARDIZATION OF LOUDNESS-BALANCE DATA FOR THE TELE-HONICS TDH-39 EARPHONE. J.R.Cox, Jr and R.C.Bilger.

Acoust. Soc. Amer., Vol. 32, No. 8, 1081-2 (Aug., 1960).

Suggested r.m.s. sound-pressure levels in N.B.S. type 9A upler corresponding to 0 and 60dB hearing levels are given for Telephonics TDH-39 earphone in an MX41/AR cushion. The gures were obtained from an average of three unpublished studies hich in each case involve a loudness balance with a WE705A rphone. H.D.Parbrook

534.6

14753 MEASUREMENT OF THE DISPLACEMENT DISTRIBUTION OF AN ULTRASONIC VIBRATOR BY MEANS OF ULTIBEAM INTERFEROMETRY.

.Sakurai, R.Shirahase and T.Anzai.

Acoust. Soc. Amer., Vol. 32, No. 7, 839-40 (July, 1960).

The displacement distribution of the vibrator of the Langevin pe was observed by means of multibeam interferometry. The displacement at various portions of the surface was measured as a hift of the contour fringes. Besides the fundamental mode at kc/s, several modes of vibration were found between 50 and 00 kc/s

534.6

14754 CALIBRATION OF INFRASONIC HYDROPHONES. O.Brandt.

custica, Vol. 8, No. 1, 31-3 (1958). In French.

Lists different types of hydrophone pointing out for each the ifficulties of calibration and describes an electrostatic method hich seems most suitable for bridging the gap between the infraonic and audible bands of frequency.

534.6

14755 ACOUSTIC MEASUREMENTS IN DEEP WATER USING THE BATHYSCAPH. M.Lomask and R.Frassetto.

. Acoust. Soc. Amer., Vol. 32, No. 8, 1028-33 (Aug., 1960).

The Bathyscaph Trieste made a series of dives for scientific urposes in the summer of 1957 in the Mediterranean Sea. Part of e work consisted of simple acoustic measurements in the 10 to 00 c/s frequency range. Ambient noise levels were measured with ome detail as a function of depth, sea state, and frequency; and ressure levels from a surface source were measured as a function f depth at different ranges, one range before the energy concentrated n the sound channel, and one range afterwards. Finally, the apabilities and limitations of the Bathyscaph as a vehicle for coustic experiments are discussed.

534.6

14756 AN INSTRUMENT FOR RECORDING CHANGES OF SOUND VELOCITY IN THE SEA.

V.D.Chesterman and M.J.Gibson.

custica, Vol. 8, No. 1, 44-52 (1958).

A continuous wave system is transmitted from one transducer o another across a fixed path, and the phase difference is measured etween transmitted and received signals. Results are given of the se of the instruments at sea under various conditions. The instrument must be used from a stationary ship, since water flow relative o the transducers is unacceptable. Other limitations are discussed.

534.6

14757 AN APPARATUS FOR THE STUDY OF ULTRASONIC PROPAGATION IN LIQUIDS UNDER PRESSURE.

R.I.Tait.

Acustica, Vol. 7, No. 4, 193-200 (1957).

A description is given of an apparatus designed for the measurement of velocity and absorption of ultrasonics in liquids. The apparatus has a capacity of two litres and can cover the range from 0 to 703 kg/cm^2 (0 to 10 000 lb/in.^{2}). A pulse method is used for both velocity and attenuation and either fixed or variable path-length can be used. Measurements in water at temperatures from 15°C to 80°C are presented and compared with recent measurements by others and with theory.

534.8

14758 NEW DEVELOPMENTS IN THE PHYSICS AND APPLICATIONS OF ULTRASOUND. J.Kolb.

Acta phys. Austriaca, Vol. 13, No. 2-3, 234-61 (1960). In German.

The paper deals briefly with recent progress in ultrasound. Reference is made to magnetostrictive transducers - nickel, useful up to 100 kc/s, aluminium—iron alloys up to about 300 kc/s, metallic oxides (NiO, CoO, FeO and Fe_2O_3) - and to piezo-electric transducers - various forms of ceramic vibrators (Barium Titanate, Clevite, zirconates, etc.) for still higher frequencies. Methods of producing extremely high ultrasonic frequencies (~0.1-1 kMc/s) using quartz vibrators are mentioned, and methods of display and measurement are discussed. The implications of ultrasonics in physics are considered particularly with reference to the velocity and attentuation characteristics of materials as a function of frequency, and to ultrasonic research at very low temperatures. In conclusion the paper has a section dealing with the technical applications of ultrasonics (e.g. ultrasonic cleaning, generation of large amplitude vibrations by means of a $BaTiO_3$ transducer on a brass cone, ultrasonic drilling tools, ultrasonic soldering irons etc.). An ultrasonic vibrator is also described for the measurement of magnetic flux and flux-gradient. A.B.Wood

534.8 : 539.14

THE PROFILE OF THE NUCLEAR ACOUSTIC RESONANCE LINE. See Abstr. 13125

534.81

14759 PART OF THE ACOUSTIC TESTING OF VIOLINS AND VIOLAS. W.Lottermoser and W.Linhardt.

Acustica, Vol. 7, No. 5, 281-8 (1957). In German.

Two techniques have been used in the Physikalisch-Technische Bundesanstalt (PTB) to test the quality of violins and violas. Resonance curves were obtained under electromagnetic forcing; the waveform excited by bowing in the normal fashion was recorded on tape and its overtone structure analysed.

534.81

14760 THE EQUALIZATION RELATION OF VIOLINS AND ITS RELATION TO THE RESONANCE CURVE.

W.Lottermoser.

Acustica, Vol. 8, No. 2, 91-8 (1958). In German.

Two new violins of medium quality and two excellent violins of Stradivarius were excited on the bridge by impulses at several frequencies. The transient phenomena differ according to the relation of the carrier-frequency to the resonances. The interpretation according to Meyer-Helmbold shows that the Stradivarius violins have shorter transients than the modern ones. This can be explained by the fact that the old Italian have, in spite of less damping and therefore greater efficiency, resonances lying close together like band-filters.

534.81

14761 TRANSIENT SOUNDS IN ORGAN PIPES. R.S.Caddy and H.F.Pollard.

Acustica, Vol. 7, No. 5, 277-80 (1957). In German.

The transient sounds produced by mechanical and direct electrical control of an organ pipe are compared. An equivalent electrical circuit is set up for the organ action in each case. Deductions from the circuits are checked with experimental evidence. It is concluded that 1st, in each case, the initial transient is controlled only by the rate of opening of the pallet, 2nd, the steady tone is independent of the action and 3rd, the presence of a key chamber controls only the duration of the closing transient.

534.81

14762 INVESTIGATION OF THE NATURAL TONE POSITIONS (FREQUENCIES) OF METAL WIND INSTRUMENTS.

E.Lieber.

Hochfrequenztech. u. ElektAkust., Vol. 69, No. 1, 29-35 (Feb., 1960). In German.

After discussing the factors controlling tone-production in metal wind instruments (e.g., the player's lip position, wind pressure, etc.), the author deals with the theoretical aspect of tone production and the "laws" involved. A comparison is made of the oscillographic records of the actual sound-pressure fluctuations in a metal wind instrument and the corresponding voltage variating in an electrical model. A table of frequencies of the sequence of natural tones of a wind instrument shows good agreement between observation and theory. A.B.Wood

534.83

14763 THE SUBJECTIVE LOUDNESS SCALE.
D.W.Robinson

Acustica, Vol. 7, No. 4, 217-33 (1957).

Discrepancies between published determinations of the sound intensity/loudness relation are not satisfactorily accounted for by differences in the test procedures. Statistical examination suggests that the variations, both between different observers and between the various investigations, may be interpreted as random errors in the subjective estimation of sensation ratios. The function relating loudness to loudness level is derived from the data. For practical purposes a simple approximation to it is proposed (2-fold change equivalent to a 10-phon step). Further work is necessary to establish the transformation function for use in computing the loudness of complex sounds from their spectra. It is probably similar to but may be distinct from the loudness function.

534.83

14764 DYNAMIC BEHAVIOUR OF OBJECTIVE LOUDNESS MEASURING APPARATUS.
H.Niese.

Hochfrequenztech. u.ElektAkust., Vol. 69, No. 1, 17-29 (Feb., 1960). In German.

Using sound pulses of variable duration, short-period single pulses of variable amplitude and short pulses of variable repetition frequency, eight different loudness measuring equipments, German and other make, were tested. A.B.Wood

534.83

14765 SUBJECTIVE MEASUREMENTS OF THE LOUDNESS OF BAND PASS NOISE, FOR EQUAL AND DIFFERENT BAND-WIDTHS PRESENTED TO EACH EAR, TO DERIVE THE LAWS OF AUDIBILITY MEASUREMENT AND THEIR APPLICATION TO OBJECTIVE LOUDNESS MEASUREMENT.
H.Niese.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 6, 202-17 (Jan., 1960). In German.

Describes an investigation of the effect on loudness when sounds of various band-widths are presented to the two ears at equal sound pressures or at different sound pressures. The investigation also deals with the effect of using very narrow or wide band-widths, and of presenting equal or different band-widths at each ear. The paper concludes with a discussion of the effect of these band-width influences on the two ears, and the probability of its application in the measurement of loudness objectively. A.B.Wood

534.83

14766 NEW DEVELOPMENTS IN THE FIELD OF LOUDNESS MEASUREMENT.
W.Reichardt.

Nachrichtentech. Fachber. (N.T.F.), Vol. 15, 1-11 (1959). In German.

The paper summarizes recent work on the subject of loudness measurement. (32 references) A.B.Wood

534.83 : 621.317.39

14767 APPARATUS FOR THE INTEGRATION OF ACOUSTIC INTENSITY. APPLICATION TO THE MEASUREMENT OF NOISE FROM MACHINES.
P.Baron.

Acustica, Vol. 6, No. 5, 412-20 (1956). In French.

A technique is described for the measurement of the total acoustic power radiated by a source. The output from a microphone traversing in a short time a path in a known surface near a source, heats an insulated block of copper. The final temperature rise can be related to the radiated sound power. A few results for the sound from electric motors are given. H.D.Parbrook

534.83

14768 AERODYNAMIC NOISE AND THE PLANE BOUNDARY.
A.Powell.

J. Acoust. Soc. Amer., Vol. 32, No. 8, 982-90 (Aug., 1960).

In an earlier paper entitled "Thoughts on Boundary Layer Noise" (Aeronautical Research Council Report 16727, 1954), it was pointed out that while the fluctuating pressures exerted upon a rigid boundary by a contiguous unsteady flow can be shown in a formal manner to generate sound as of a distribution of dipoles, it can be argued by means of the reflection principle that all such dipole effects cancel out in the case of the boundary being plane; yet observations of aeolian tones adequately confirm the presence of effective dipole-like generators in that case. Here the image principle is developed in a rigorous manner and the apparent paradox is resolved with the help of an extension of Lighthill's (Abstr. 3372 of 1952) and Curle's (Abstr. 8567 of 1955) analyses to include boundaries which are not wholly immersed in the noise-generating flow. In particular, it is shown that the pressures exerted on a plane boundary are simply reflections of the quadrupole generators of the flow itself; thus the pressure dipoles account for an enhancement of the quadrupole powe in fact a quadrupling when the wavelength is relatively large, except that degeneration into octupoles occurs for those lateral quadrupole of the type that would be associated with fluctuations across the shear of an adjacent boundary layer. Under these circumstances it should be possible to estimate the noise of a plane turbulent boundar layer with satisfactory accuracy from sufficient knowledge of the principal quadrupole source strength alone (provided that it is reasonable to neglect the contribution of the fluctuating shear stres acting on the boundary).

534.8

14769 OBLIQUE AIR-TO-GROUND SOUND PROPAGATION OVER BUILDINGS.
P.H.Parkin and W.E.Scholes.

Acustica, Vol. 8, No. 2, 99-102 (1958).

The propagation sideways to the ground of the sound emitted by helicopters has been investigated in a built-up area. Over the horizontal distances covered (about 920 m 3000 ft) it was found (a) that the attenuation (i.e. all losses in excess of the inverse square reduction) at frequencies up to 1000 c/s was small and independent of the weather for helicopter heights of greater than about 100 m (300 ft); and (b) that at lower heights, the attenuation increased considerably.

534.8

14770 EXPERIMENTS WITH ROOM ACOUSTICS MODELS.
H.J.Zemke.

Nachrichtentech. Fachber. (N.T.F.), Vol. 15, 56-62 (1959). In German.

The author is of the opinion that using the model technique a clearer picture is obtained of the influence of geometrical form on the sound propagation and on echo formation and sound concentratio in auditoria. Experiments are described in which models of five well-known German auditoria were studied. It is considered that su studies may result in a saving of much time and material when planning full-scale auditora. A.B.Wood

534.84

14771 MEASUREMENT OF THE DIFFUSIVITY OF SOUND FIELDS BY MEANS OF CORRELATION.
P.Dämmig.

Acustica, Vol. 7, No. 6, 387-98 (1957). In German.

Theoretical studies of the correlation coefficients for sound fields in very large halls, and in halls of dimensions comparable with the separation of the microphones used for the measurement, show that such correlations do not uniquely describe the diffusive properties of such rooms, and this whether the signals arriving at the pick-up points are coherent or incoherent. They are often characteristic of a given diffusivity but not completely so. The sensitivity of the technique of measurement becomes small especially when the diffusion is considerable. These facts are illustrated for certain special cases in a model experiment with arrays of loudspeakers, forming an octant of a sphere. There is good agreement between theory and experiment.

534.84

14772 ACOUSTIC INSULATION OF BUILDING STRUCTURE.
M.J.Pujolle.

Acustica, Vol. 8, No. 1, 27-30 (1958). In French.

Information is presented on various factors which affect the acoustic insulation of walls, i.e. mass and rigidity of the walls; binding of elements of the structure, their suspension, distance apart and filling; position of microphones and joints.

534.84

14773 SPECTRAL ANALYSIS OF ACOUSTIC WAVES IN THE TRANSISTORY REGION IN A CLOSED CHAMBER.
S.Czarnecki.

Acustica, Vol. 8, No. 5, 291-5 (1958). In French.

An analysis is made of the influence of a number of sound sources on the frequency spectrum of an acoustic wave in the transistory region. It is shown that the irregularity of the sound decay in a room also has an influence on this spectrum.

534.84

14774 ABACS FOR THE CALCULATION OF THE [LOW FREQUENCY] ACOUSTIC ABSORPTION OF PERFORATED WALLS.
P.Lienard.

Acustica, Vol. 8, No. 2, 86-90 (1958). In French.

534.84

14775 SOUND ABSORPTION OF A STONE WALL.
E.J.Evans and P.H.Parkin.

Austica, Vol. 8, No. 2, 117-18 (1958).

A Hollington stone wall at one time proposed for use in the new ventry Cathedral was required to have an absorption coefficient o at least 0.2 between 250 and 1000 c/s. The absorption coefficient the stone itself was less than 0.05 at all frequencies. The neces-sy absorption was obtained by leaving 2.5 cm gaps between the vtical faces of the stone blocks, these acting as resonators. They vre filled with glass-wool and varied in depth to give the required badband absorption.

534.84

14776 ACOUSTICAL FEATURES OF THE ADDITION TO THE PHYSICS BUILDING AT THE UNIVERSITY OF TEXAS.
B.Watson.

Acoust. Soc. Amer., Vol. 32, No. 8, 1034-7 (Aug., 1960).

Detailed description is given of the acoustic designs used in the dition to the Physics Building at the University of Texas. Sound sorption is included in the lecture rooms in the form of an oustic blanket behind a pierced glazed brick wall to give a reson-t absorption with maximum coefficient at 500 c/s of 0.60, reducing 0.40 at 125 c/s and to 0.25 at 4000 c/s, and in the form of a slit sorber having a resonance at about 400 c/s with coefficient of 55, reducing to 0.45 at 125 c/s and 0.33 at 4000 c/s. Sound diffusion d projection in these lecture rooms is secured by sound reflectors er the speaker's position, non-parallel side walls, and light xture coves in the ceiling. Sound absorption in some of the boratories is provided by use of functional absorbers each using acoustic blanket free on one side and confined by a perforated rdboard on the other. Measurements on two such rooms show a sonant absorption is obtained with peak frequency at 500 c/s, and th apparent absorption coefficient near unity at the peak, dropping 0.70 at 125 c/s and to 0.50 at 4000 c/s.

534.88

14777 DIGITAL ARRAY PHASING.
V.C.Anderson.

Acoust. Soc. Amer., Vol. 32, No. 7, 867-70 (July, 1960).

The extension of digital techniques to the problem of processing he output of an array of point receiving elements in an acoustic eld has given rise to a method of phasing called D.I.M.U.S. digital multibeam steering). This digital technique incorporates the se of shift registers as delay line elements which results in a umber of operational advantages. A description of the D.I.M.U.S. echnique is given. The effects of amplitude and time quantization mposed by the digital circuits are considered in the light of the elative signal processing gain of the array referred to an exact nalogue phasing network. The processing gain is computed as a unction of sampling frequency for a number of types of signal.

534.88

14778 SMALL SIGNAL DETECTION IN THE DIMUS ARRAY.
P.Rudnick.

. Acoust. Soc. Amer., Vol. 32, No. 7, 871-911 (July, 1960).

In the D.I.M.U.S. system for steering an acoustic array, the utput of each element is reduced to a sequence of polarity samples nd delayed by an integral multiple of the sampling period. Calcu-ations are given to show the effect of this process on the passive etection threshold of an array beam (in isotropic Gaussian noise) oth in general and numerically for several examples. In these, ver-all losses range from 0.5 to 1.5 dB.

534.88

14779 A SYSTEMATIC ERROR IN UNDERWATER ACOUSTIC DIRECTION-FINDING. J.J.Freeman.

. Acoust. Soc. Amer., Vol. 32, No. 8, 1025-7 (Aug., 1960).

Postulating a uniform volume distribution of noise sources as a odel of ambient ocean noise, the effect of the coherence between oise measured at different locations is examined. The systematic rror introduced by this coherence in cross-correlator direction-inding systems is evaluated. Also, the relation of the maximum seful averaging time to the degree of coherence is derived.

OPTICS . PHOTOMETRY

535.1

14780 THE THEORY OF PHOTON PACKETS AND THE LENNUIER EFFECT. L.M.Falicov.

Nuovo Cimento, Vol. 16, No. 2, 247-59 (April 16, 1960).

The quantum electromagnetic field of radiation is studied for the case of a spectral distribution of energy and momentum. Packets of photons are introduced and classified. Some of their coherence properties are discussed by associating equivalent classical fields with each packet. The emission and dispersion of such packets are studied with special emphasis on the fluorescence resonance of frequencies near the atomic frequency. A scattered packet is shown to contain frequencies not present in the incident radiation, as found experimentally by Lennuier (Abstr. 2522 of 1947), and the apparent non-conservation of energy is seen to be a consequence of the Heisenberg uncertainty principle.

535.24

14781 DOUBLE MODULATION PHOTOMETER.
H.P.Kalmus.

Rev. sci. Instrum., Vol. 31, No. 8, 828-32 (Aug., 1960).

A radio-frequency signal, gated at an audio rate, is applied to a bridge circuit. One arm of the bridge circuit is a phototube or a photomultiplier; the corresponding arm is a capacitor. The bridge is balanced in the absence of photocurrent, unbalanced in its presence, with the degree of unbalance being proportional to the average value of the photocurrent (dark current is cancelled by an auxiliary circuit). The null detector is an a.c. amplifier having a bandpass centred at the audio gating frequency, followed by a synchronous detector tuned to the same frequency. The circuits require no critical adjustments; impedances are well below the levels used in electrometer circuits, and the ultimate sensitivity is limited only by the statistical fluctuations in the dark current. At room temperature, the stability of the zero level is determined by the constancy of the mean level of the dark current. The new method makes it possible to produce stable instruments with a maximum full-scale sensitivity of 4×10^{-9}lm whereby, with a bandwidth of 1 c/s, a signal-to-noise ratio of 100 is maintained.

535.24 : 77

14782 SIMPLE CONTINUOUS CHART AND INTEGRATING DEVICE FOR A JOYCE—LOEBL MICRODENSITOMETER Mk. I. G.Farrow and D.Preston.

J. sci. Instrum., Vol. 37, No. 9, 347-9 (Sept., 1960).

Two simple devices are described which may be added to a Joyce—Loebl microdensitometer. The continuous chart device enables a chosen expansion ratio of any film being scanned by the microdensitometer to be recorded on one piece of chart paper. The existing mechanical link between the original chart table and film carriage table has been preserved. The integrating attachment allows the area beneath the recorded trace to be determined while the trace is being produced.

535.24

14783 TEST-TUBE ADAPTOR FOR USE IN OPTICAL DENSITY MEASUREMENTS. J.B.Dawson.

J. sci. Instrum., Vol. 37, No. 8, 304 (Aug., 1960).

An adaptor is described in which the space between the cylindrical test-tube and the parallel windows of the cell, is filled with a liquid of suitable refractive index, converting the "test-tube cell" effectively into a parallel sided one. Figures are given showing the improvement obtained. E.G.Knowles

535.24 : 621.317.39

14784 DAYLIGHT FACTOR METER.
D.P.Turner.

J. sci. Instrum., Vol. 37, No. 9, 316-17 (Sept., 1960).

A brief survey and criticism of existing methods of measuring daylight factors is followed by a description of an improved daylight factor meter, in which the current outputs of two photoelectric cells are compared by a null-balance method. When one cell is exposed inside the building and the other outside, the ratio of the illuminations at the two positions is indicated directly on a calibrated scale by the balance position of the potentiometer. The circuit is so arranged that the load resistances of the cells are unchanged by changes in the balance position and, for a constant daylight factor, the balance position is not affected by changes in the average luminance of the sky. The instrument can be calibrated directly on an optical bench, either for use with the outside cell exposed to a full hemisphere of sky or for use with the outside cell so masked that light is only received from a part of the sky.

535.24

14785 PHOTOMETRY OF TOROIDAL LIGHT SOURCE. I. LIGHT DISTRIBUTION DUE TO TOROIDAL LIGHT SOURCE WITH FINITE THICKNESS. Y.Nayatani and Y.Kurioka.
Bull. Electrotech. Lab (Tokyo), Vol. 22, No. 4, 272-80 (April, 1958).
In Japanese.

535.24

14786 DETERMINATION OF THE RADIAL DISTRIBUTION OF BRIGHTNESS IN A CYLINDRICAL LUMINOUS MEDIUM WITH SELF-ABSORPTION. M.P.Freeman and S.Katz.
J. Opt. Soc. Amer., Vol. 50, No. 8, 826-30 (Aug., 1960).

The two-path method (utilizing a mirror) is shown to provide sufficient information to solve for the true radial brightness distribution of a luminous medium in the presence of self-absorption. In the case where self-absorption is not large, an approximate solution to the problem is shown to be no more difficult than a solution for the "optically thin" approximation.

535.24 : 551.5

RELATIVE ENERGY DISTRIBUTION OF DAYLIGHT FROM OVERCAST SKY. See Abstr. 14297

GEOMETRICAL AND INSTRUMENTAL OPTICS SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535.3 : 530.19

INCORPORATION OF ERROR FUNCTION ABSORPTION COEFFICIENT IN TRANSPORT EQUATION. See Abstr. 14549

535.3

14787 DIFFUSION OF ULTRAVIOLET AND VISIBLE LIGHT BY GROUND SURFACES OF FUSED QUARTZ.
W.E.K.Middleton.
J. Opt. Soc. Amer., Vol. 50, No. 8, 747-9 (Aug., 1960).

The diffusion of light by the ground surfaces of samples of fused quartz has been investigated at various wavelengths between 253.7 and 546.1 mμ. The surfaces were ground with abrasives having various particle sizes, and the experiments were made with both the ground and the unground side of the sample facing the light. They were also made with the light incident at various angles and collected in a normal direction, as well as with the light incident normal and collected at various angles. The dependence of the apparent spectral radiance on wavelength and angle is shown.

535.3

14788 REFLECTION AND REFRACTION AT A RANDOM MOVING SURFACE. I. PATTERN AND PATHS OF SPECULAR POINTS. M.S.Longuet-Higgins.
J. Opt. Soc. Amer., Vol. 50, No. 9, 838-44 (Sept., 1960).

Light falling from a point source on a ruffled surface produces a pattern of images, which move about over the surface. The image points correspond to the maxima, minima, and saddle points of a certain function. It is shown that the images are generally created in pairs, a maximum with a saddle point or a minimum with a saddle point, and that the total numbers of maxima, minima, and saddle points satisfy the relation $N_{ma} + N_{mi} = N_{sa} + 1$. The process of creation or annihilation of images is studied in detail, and also the tracks of the image points, in certain special cases. It is shown that closed tracks may be common. This is confirmed by photography of the sea surface.

535.3

14789 REFLECTION AND REFRACTION AT A RANDOM MOVING SURFACE. II. NUMBER OF SPECULAR POINTS IN A GAUSSIAN SURFACE. M.S.Longuet-Higgins.
J. Opt. Soc. Amer., Vol. 50, No. 9, 845-50 (Sept., 1960).

The number of specular points reflected in a random Gaussian surface is determined theoretically under the following alternative conditions: (1) when the surface is perfectly long crested (two-dimensional); (2) when the surface is three-dimensional but isotropic; (3) for quite general surfaces, provided that the observer and the source of radiation are both at a great distance from the surface. The results can be applied to the similar problem when the surface forms the boundary of two refracting media.

535.

14790 REFLECTION AND REFRACTION AT A RANDOM MOVING SURFACE. III. FREQUENCY OF TWINKLING IN A GAUSSIAN SURFACE. M.S.Longuet-Higgins.
J. Opt. Soc. Amer., Vol. 50, No. 9, 851-5 (Sept., 1960).

When light is reflected or refracted at a moving Gaussian surface, the observer sees a number of moving images of the source, which appear or disappear generally in pairs; such an event is calle a "twinkle". The number of twinkles per unit time is evaluated in terms of the frequency spectrum of the surface and the distance of the source O and observer Q, on the assumption that the surface is Gaussian and that OQ is perpendicular to the mean surface level. A solution is found first for a single system of long crested (or two-dimensional) waves, and then extended to the case of two such systems intersecting at right angles. The rate of twinkling is found to depend, apart from a scale factor, on two parameters of the surface, one of which, α, increases steadily with the distance of O or Q from the surface; the other, d, discriminates between waves of standing type and waves of progressive type. Over a considerable range of α, the rate of twinkling is almost independent of d, but for large values of α the rate is much greater for standing waves than for progressive waves; waves of intermediate type are included in the analysis.

535.31

14791 ON GABOR'S EXPANSION THEOREM.
K.Miyamoto.
J. Opt. Soc. Amer., Vol. 50, No. 9, 856-8 (Sept., 1960).

As a generalization for optics of the well-known sampling theorem of information theory, Gabor proposed an expansion theorem. It relates to the number of independent solutions of the wave equation in a region defined by the object and by the aperture of an optical system. A proof of this theorem presents formidable difficulties but a proof relating to important cases is established and a more accurate estimate for the number of the independent solutions in the general case is given.

535.31

14792 GENERAL RELATION BETWEEN OBJECT AND INVERTED IMAGE SPACE IN PLANE-MIRROR OPTICS
G.R.Rosendahl.
J. Opt. Soc. Amer., Vol. 50, No. 9, 859-61 (Sept., 1960).

Any transformation between an object space and an inverted image space, i.e., any desired mirror image of the object space, can be realized by a set of three mirrors. Formulas are derived which permit one to determine a set of three mirrors from a desired light direction and attitude in image space as compared to those in object space. The geometry of such a set of three mirrors is discussed. The theory is applied to two examples.

535.31

14793 A POINT SOURCE OF LIGHT IN AN ABSORBING MEDIUM BETWEEN PARALLEL PLANE SURFACES.
I.N.Minin.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 74-6 (July 1, 1960).
In Russian.

Sobolev's method [Dokl. Akad. Nauk SSSR, Vol. 42, 176 (1944)] is used here to obtain illumination of plane surfaces (isotropic reflectors) enclosing an absorbing medium at the centre of which there is a point source. The illumination functions satisfy Abel's integral equations which are solved in terms of multiple integrals of Bessel's functions. J.K.Skwirzynski

535.31

14794 LOW-CONTRAST IMAGES WITH PARTIALLY COHERENT ILLUMINATION. S.Slansky and A.Maréchal
C.R. Acad. Sci. (Paris), Vol. 250, No. 25, 4132-4 (June 20, 1960).
In French.

The intensity distribution in the image is expressed in terms of a convolution between the complex transmission of the object, assumed to differ from unity by a small quantity, and the amplitude distribution in the image of a point. Applications to the calculation of image quality in the presence of aberrations are indicated. W.T.Welford

535.31

14795 USE OF ANNULAR APERTURES TO INCREASE FOCAL DEPTH. W.T.Welford.

Opt. Soc. Amer., Vol. 50, No. 8, 749-53 (Aug., 1960).

A theoretical study is made of the possibilities of using an nular aperture to increase the focal depth of a photographic obctive. It is shown that for a given gain in focal depth, the loss in eed is the same for both annular apertures and conventional opping down. For images of isolated point objects, the definition improved by using an annular stop. The gain in focal depth is ss for off-axis points, but it is found that, for example, a factor of 7 in focal depth gained by means of an annular aperture is barely fected at a field angle of 30°.

535.31

14796 SOME PROBLEMS IN THE GEOMETRICAL OPTICS OF TOROIDAL SURFACES. J.Casas and J.Barcala.

tti Fond. Ronchi, Vol. 15, No. 2, 169-215 (March-April, 1960). Spanish.

This is the first paper of a comprehensive account of image rmation by toroidal surfaces. It derives the equations for ray acing by algebraic methods through a lens system and deduces the y distribution in the image plane. Typical illumination patterns e calculated. R.W.Fish

535.31 : 621.383

14797 OPTICS FOR INFRARED SYSTEMS.

R.M.Scott.

roc. Inst. Radio Engrs, Vol. 47, No. 9, 1530-6 (Sept., 1959).

A review article, describing the imaging properties of lens d mirror systems, and the more important aberrations which cur. C.Hilsum

535.31

14798 SIMPLE FORMULAE FOR ESTIMATION OF THE ABERRATIONS OF A MIRROR OBJECTIVE. K.I.Tarasov.

ptika i Spektrosk., Vol. 8, No. 5, 723-5 (May, 1960). In Russian.

Simple formulae are given for calculation of the spherical berration, coma, astigmatism and field curvature of a spherical irror objective with an arbitrary position of a diaphragm. A.Tybulewicz

535.31

14799 ON THE THICK LENS.

A.Biot.

nn. Soc. Sci. Bruxelles I, Vol. 74, No. 2, 106-19 (1960). In French.

A study of the power and chromatic aberration of a diverging hick lens as a function of thickness and curvatures, using known ormulae. W.T.Welford

535.31

14800 THE TRANSVERSE CHROMATIC ABERRATION OF AN OPTICAL SYSTEM BETWEEN TWO DIFFERENT EDIA. A.Biot.

nn. Soc. Sci. Bruxelles I, Vol. 74, No. 2, 100-5 (1960). In French.

The two expressions derived involve the overall properties of he system, not the surface-by-surface properties, together with he dispersions of the initial and final media. One expression inolves the focal lengths and the object and pupil abscissae, the other oes not contain the focal lengths and is therefore applicable to focal systems. W.T.Welford

535.31

14801 A CRITICAL EXAMINATION OF THE USE OF RESOLVING POWER AS A TEST CRITERION FOR ERTAIN LENSES. S.Guidarelli.

Atti Fond. Ronchi, Vol. 15, No. 2, 161-8 (March-April, 1960). In Italian.

While resolving power may be the proper criterion in most ptical systems, there are others in which it does not appear to be the most appropriate criterion. Examples are instruments requiring alignment to be carried out or using stereoscopic acuity. In such cases microphotometric gradient measurements on a slit image are superior. R.W.Fish

535.32

14802 RECENT MEASUREMENTS OF OPTICAL CONSTANTS IN THE INFRARED REGION.

J.Vincent-Geisse and J.Lecomte.

J. Phys. Radium, Vol. 20, No. 11, 841-8 (Nov., 1959). In French.

Measurements have been made of refraction and absorption indices of different substances, between 1 and 30 μ, at the Sorbonne Infrared Laboratory. In regions of transparency, the refractive index has been determined by the classical methods of a minimum deviation prism and of total reflection. For liquids, and in regions of weak absorption, an improved interference spectra method has been used. In cases of strong absorption, the optical constants have been determined by a new reflection method. The principle of each method is briefly described together with some of the results. Finally, the technique of Christiansen filters is reviewed and its usefulness in some particular cases is pointed out.

535.32

14803 MEASUREMENT OF THE REFRACTIVE INDEX OF SOME LIQUIDS IN THE INFRARED BY AN INTERFEROMETRIC METHOD. J.Vincent-Geisse and J.Lecomte.

Rev. Opt., Vol. 37, No. 6, 295-305 (June, 1958). In French.

A variable thickness container having its sodium chloride plates coated with a thin layer of high reflecting power is used as an interferometer. The use of a double-beam spectrograph allows the absorption effects of the liquids to be partially eliminated. A new method is presented which enables the interference order to be determined. Refractive indices can be easily measured in the range 1-15μ.

535.8

14804 AUTOMATIC COMPUTATION IN GEOMETRICAL OPTICS. A.Girard.

Rev. Opt., Vol. 37, No. 5, 225-41 (May); No. 8, 397-424 (Aug., 1958). In French.

Describes a method of automatic optical design. Rays are traced through a roughly designed system and the partial derivatives of the transverse ray aberrations with respect to constructional data computed. Changes in the system are then made so as to minimize the sum of squares of aberrations and the cycle is repeated. Examples of the application of the process to doublet telescope objectives and to a Cooke triplet are given. W.T.Welford

535.8 : 534.13

FIXING POINTS OF DOUBLE-CONVEX QUARTZ LENSES.

See Abstr. 14713

535.8

14805 APPARATUS FOR THE SPECTRAL STUDY OF FLUORESCENCE IN MICROSCOPY.

M.Neves E Castro, M.Françon and M.Rousseau.

Rev. Opt., Vol. 37, No. 8, 385-90 (Aug., 1958). In French.

The optical set-up consists of a microscope provided with an ultraviolet illuminator and a spectrograph designed for spectral analysis. Quartz optical parts are used between the light source and the specimen. The objective and eye-piece of the microscope as well as the optical elements of the spectrograph are made of glass. A calibration device allows a photometric comparison of the spectra from various details of one or several specimens.

535.8

14806 PRECISE MEASUREMENT BY IMAGE-SPLITTING.

J.Dyson.

J Opt. Soc. Amer., Vol. 50, No. 8, 754-7 (Aug., 1960).

The image-splitting principle offers important advantages over the use of filar micrometers or graticules for the measurement of an image transmitted through an optical system. A method for applying this principle to the microscope is described. Theoretical considerations indicate that a setting accuracy of one-tenth of the radius of the Airy disk should be attainable and it is shown that under certain conditions no systematic error is introduced. Experiments are described which substantiate these conclusions and illustrate some applications of the instrument.

535.8

14807 PASSAGE OF LIGHT THROUGH OPTICAL WAVEGUIDES.

A.R.Daich, Yu.A.Tsirlin and L.É.Pargamanik.

Optika i Spektrosk., Vol. 8, No. 5, 713-20 (May, 1960). In Russian.

Passage of light through cylindrical optical waveguides with specularly reflecting walls is discussed using the geometrical-optics approximation. The transmission coefficient is obtained and the dependence of this coefficient on the waveguide dimensions and conditions of reflection at the walls is discussed. Waveguides of various types are compared. A.Tybulewicz

535.8

14808 OPTICAL MATERIALS, FILMS, AND FILTERS FOR INFRARED INSTRUMENTATION.

W.L.Wolfe and S.S.Ballard.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1540-6 (Sept., 1959).

A review article, which gives the optical, thermal and mechanical properties of the optical materials, discusses the films used on optical components for protection or for reducing reflection, and briefly describes plastic filters, semiconductor filters and interference filters. C.Hilsum

535.8

14809 SILICON IN INFRARED OPTICS.

R.Aries and E.Labin.

Onde elect., Vol. 39, 854-7 (Nov., 1959). In French.

Single crystal n-type silicon with a resistivity between 2 and 30 ohm cm is very satisfactory as an infrared optical material. Its properties are summarized, and comparison is made with other optical materials. C.Hilsum

535.8 : 621.396.969.34

14810 INFRARED SEARCH SYSTEM DESIGN CONSIDERATIONS.

R.H.McFee.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1550-2 (Sept., 1959).

The different types of mechanical scanning systems are briefly described and some examples of practical systems are given. C.Hilsum

535.8 : 621.396.969.34

14811 OPTICAL-MECHANICAL SCANNING TECHNIQUES.

M.R.Holter and W.L.Wolfe.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1546-50 (Sept., 1959).

Various scan patterns are described, and the performance of a prism scanner used in an aircraft is considered in detail. The problems of scanning at very low and very high altitudes are analysed, and the design is given of prism scanners for these applications. C.Hilsum

535.8 : 538.56 : 621.396.969.34

14812 COMBINED OPTICAL—MICROWAVE SYSTEM CONSIDERATIONS.

S.H.Cushner.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1553-4 (Sept., 1959).

A short discussion of detecting systems which are sensitive to both infrared radiation and microwaves. C.Hilsum

535.8 : 621.396.969.34

14813 THE TECHNIQUE OF SPATIAL FILTERING.

G.F.Aroyan.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1561-8 (Sept., 1959).

Spatial filtering is a method for improving the efficiency of an optical system used for detecting targets. The space filter enhances the salient dimensional features of the target at the expense of dimensional detail received from undesired radiation in the background. It usually consists of a field stop and a reticle located at the focal plane. The reticle is a pattern of opaque and transparent parts, and it can simultaneously scan and modulate the image. After a mathematical analysis and some consideration of background radiation, the design of optimum space filters is described. C.Hilsum

535.8

14814 VARIABLE PHASE-CONTRAST ARRANGEMENT FOR THE MEASUREMENT OF ABSOLUTE LIGHT PHASE.

R.Fleischmann and A.Lohmann.

Z. Phys., Vol. 159, No. 3, 348-59 (1960). In German.

In the methods presented, a known periodic object (e.g. a phase grating) in the object plane produces a discrete spectrum in the pupil plane, the zeroth and higher orders of which can easily be influenced independently. This is done by the unknown phase object acting as the phase strip in the pupil plane. The influence of the strip on the final image is compensated by adjusting a second, variable, phase strip, or by superimposing a variable amount of dark-field image to give zero contrast in the final image. Phase and amplitude of the unknown object can then be calculated from the half-shadow setting parameters.

535.8 : 621.396.969.34

14815 OPTICAL FILTERING.

L.W.Nichols.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1569-70 (Sept., 1959).

Optical filters can be used in infrared detection systems to reduce the effect of stray radiation from the sun, clouds and simil objects. Some transmission curves are given for suitable filters. C.Hilsu

535.

14816 MEASUREMENT OF THE INTENSITIES OF RAMAN LINES.

H.W.Schrötter.

Z. angew. Phys., Vol. 12, No. 6, 275-80 (June, 1960). In German.

Two photomultipliers are used to measure the ratio of intensit of exciting and Raman lines, the ratios being recorded against wav length on a pen recorder. An integrating circuit is used to record also the total intensity of each Raman line; the latter accord well with planimeter integrations of the lines. Wavelength variation of monochromator transmission and photocell sensitivity are determined and allowed for. Relative intensities of about 60 Hg lines in the range 3900-6250 A for the Toronto source used are tabulated. It is shown how to correct for absorption by the specimen of exciting lines and Raman lines. G.F.Lothia

535.

14817 ON THE OBSERVATION OF RAMAN SPECTRA OF POWDERED CRYSTALS.

H.Moser and D.Stieler.

Z. angew. Phys., Vol. 12, No. 6, 280-8 (June, 1960). In German.

Observations are compared with four specimen mountings: (a) back scattering from a plane surface; (b) specimen at the centr of an Ulbricht sphere; (c) transmission through a pressed disk; (d) specimen illuminated through the walls of a containing tube and observed through a hollow conical end. From (a) to (d) the exposu time decreases 4 times and the smallest observed Raman wavenumber decreases from 400 to 13 cm^{-1}. Wave numbers and intensities are measured and tabulated for p-dichlorobenzene and naphthalene. G.F.Lothia

535.3

14818 USEFUL REPRESENTATIONS FOR MEASUREMENTS OF SPECTRAL BAND ABSORPTION.

G.N.Plass.

J. Opt. Soc. Amer., Vol. 50, No. 9, 868-75 (Sept., 1960).

Three different methods are discussed for the representation of laboratory measurements of spectral band absorption. Each method is valid over a considerable range of pressure and amount of absorbing gas; together they accurately represent the absorption for virtually all values of these variables by means of reasonably simple mathematical expressions. Since these approximations hav a valid theoretical basis, they can be used to obtain reliable values of the absorption for pressures and amounts of absorbing gas outside of the original experimental range. The three methods are (1) strong line approximation; (2) weak line approximation; (3) nonoverlapping line approximation. Methods (1) and (2) are valid regardless of whether or not the spectral lines overlap. Method (3) is valid regardless of whether or not the absorption is weak or strong at the line centres. The regions of validity of each of these approximations are given for the Elsasser and statistical models. An analysis is made by these methods of the published data on the absorption of the 9.6 μ band of ozone.

535.3

14819 ECHELLE-TYPE SPECTROGRAPH FOR THE NEAR INFRARED.

D.H.Rank, D.P.Eastman, W.B.Birtley, G.Skorinko and T.A.Wiggins.

J. Opt. Soc. Amer., Vol. 50, No. 8, 821-5 (Aug., 1960).

The 5 m evacuable double-passed grating spectrograph previously described (Abstr. 155 of 1960) has been modified so that all but 10 in. of the total optical path is now evacuable. The foreprism system has been redesigned so that overlapping high-order i spectra can be separated allowing the use of coarse gratings. Provision is made to keep the band pass of the foreprism monochromator in synchronization with the rotation of the grating. An addition to the scanning system provides wavelength markers on the recorder chart. The wavelength marker system is arranged so that accelerated scanning can be performed in traversing regions where lines are not being measured. The marker system is also useful in expediting the measurement of small frequency shifts. The procedu used for accurate determination of the dispersion by means of interferometric calibration is described.

535.3

14820 HIGH-SPEED PHOTOELECTRIC SPECTROMETER FO THE 0.4-0.9μ REGION.

N.G.D'yachenko.

Optika i Spektrosk., Vol. 8, No. 3, 398-9 (March, 1960). In Russian.

Describes a simple scanning device which uses an oscillating rror, by means of which up to 400 spectra can be obtained in c (800 in the case of "mirror' spectra). The resolving power e instrument is about 300. A.Tybulewicz

535.33

4821 REFLECTOMETER FOR THE VACUUM ULTRAVIOLET. A.Smith.

pt. Soc. Amer., Vol. 50, No. 9, 862-4 (Sept., 1960).

A newly designed device for the measurement of absolute ectance in the vacuum region is discussed. Notable features his reflectometer are compactness and simplicity. The source monochromator with which the reflectometer is used are also ussed. The system produces data in the wavelength range to 2500 A at any angle of incidence between 15° and 80°. A ple reflectance curve for a crystal of KCl is shown.

535.33

14822 A HIGH LUMINOSITY QUARTZ SPECTROGRAPH FOR THE FAR ULTRA-VIOLET REGION λ 2300—1850 Å. U. isiel and H.Niewodniczański.

a phys. Polon., Vol. 17, No. 5, 361-4 (1958).

A description is given of a small quartz spectrograph of high sitivity (1 : 1.82) using a Cornu-type double prism. In order to id the influence of the absorption of atmospheric oxygen, CO_2 s blown through the spectrograph. The most favourable conditions the spectral region 2000-1850 A are when the plateholder makes angle of 27° with the optical axis of the camera lens. The mean ear dispersion at such an adjustment is 17 A/mm.

535.33

14823 ULTRAVIOLET WAVELENGTH RANGE EXTENSION OF THE GENERAL ELECTRIC SPECTROPHOTOMETER. Grum and P.T.Scharf.

Opt. Soc. Amer., Vol. 50, No. 8, 816-19 (Aug., 1960).

The wavelength range of the General Electric spectrophotometer n be extended into the near-ultraviolet spectral region. The cam- i extension technique usually employed for i.r. work is not olicable in the u.v. region. An accessory consisting of two glass dges can be used to give both u.v. and i.r. extensions. Details the accessory and results obtained by its use are described.

535.33

14824 ADAPTATION OF THE JOBIN—YVON [ELECTRONIC] SPECTROPHOTOMETER TO MICROSCOPY. Elias, M.Françon and P.Lostis.

v. Opt., Vol. 37, No. 6, 305-9 (June, 1958). In French.

The cell unit is removed in order to interpose the microscope tween the monochromator and the receiver unit. A telescope, put mediately after the monochromator and before the microscope, ows the preparation to be observed on the spot where the ectral variation of absorption is to be studied. This spectro- otometer has a range from 2200 A to about 1μ. In the ultraviolet gion the glass objective of the microscope is replaced by a rror system which can be used also in the infrared. The instru- ent was designed for investigating spectra absorption curves.

535.33

14825 IMPROVEMENT IN RESOLVING POWER OF A SPECTROGRAPH BY INTERFERENCE WITH THE TERMEDIARY IMAGE. R.Mănăilă.

v. de Physique (Bucarest), Vol. 5, No. 1, 33-9 (1960). In French.

According to the theory of image formation, light incident upon object is divided into a direct wave and a diffracted wave. The termediary image is that of the luminous source formed by the rect wave and the diffracted wave. In a spectrograph a fine wire used to cover the image formed by the direct wave and this is own to yield an increased resolving power. An outline of the eory is given and some photographic results illustrating the provement obtainable are reproduced. R.W.Fish

535.33

14826 RAPID SCANNING MICROSPECTROFLUORIMETER. R.A.Olson.

ev. sci. Instrum., Vol. 31, No. 8, 844-9 (Aug., 1960).

An apparatus is described in which spectra of microscopic jects can be continuously scanned. An adjustable linear spiral slit otated at 2 r.p.s. provides an oscillographic presentation of either mission or absorption spectra. The apparatus was developed rimarily for the study of fluorescent structure in connection with e photochemistry of living cells. An alternate modification pro- ides the simultaneous recording of the time course of spectral hanges at several selected wavelengths. Performance data and xamples of biological application are presented.

535.33

14827 CALCULATION OF THE RESOLVING POWER OF A SPECTROGRAPH WITH TWO CONCAVE GRATINGS AT GLANCING INCIDENCE. P.Jaegle.

C.R. Acad. Sci (Paris), Vol. 250, No. 22, 3620-1 (May 30, 1960). In French.

The distribution of intensity in the diffraction figure of the diffracted X-ray beam from a double grating spectrograph at grazing incidence is investigated. It is found that the resolution of an ordinary curved grating spectrograph should be greatly improved without loss of intensity by the addition of a second, suitably placed curved grating. T.Mulvey

535.33 : 545

14828 PHOTOELECTRIC EMISSION ANALYSIS WITH PRISM SPECTROGRAPHS OF MEDIUM DISPERSION. DETERMINATION OF SILICON AND PHOSPHORUS IN IRON. J.Maierhofer and H.Krempl.

Z. angew. Phys., Vol. 12, No. 4, 159-68 (April, 1960). In German.

Describes an attachment to a quartz spectrograph (Zeiss Q24 or Fuess 110M) consisting of 4 exit slits and photomultipliers each with integrating circuits. Optical conditions for high resolution and high intensity of illumination are considered, particularly the alignment of the source and the transmission characteristics of various types of silica. Performance is tested by estimations in iron and steel of Si (λ = 2882 A; standard deviation 2% for content 1-3%) and of P (λ = 2149 A; standard deviation 5% for content 0.01%). G.F.Lothian

535.33

14829 LOW-TEMPERATURE CHAMBER FOR INFRARED STUDIES OF CRYSTALS. M.Cadène and C.Deloupy.

J. Phys. Radium, Vol. 19, No. 4, 506-7 (April, 1958). In French.

Describes a cryostat in which measurements of the optical properties of crystals may be undertaken at liquid nitrogen temperatures. The temperature of the cryostat may be set to any desired figure near −180°C to an accuracy of about ±1°C. The specimen may be rotated within the chamber, and interchangeable windows are provided so that optical measurements may be extended from the visible region to wavelengths of 40 μ. C.H.B.Mee

535.33

14830 TEMPERATURE COMPENSATION OF SINE-DRIVE MONOCHROMATORS. D.L.Dimock.

J. Opt. Soc. Amer., Vol. 50, No. 8, 819-20 (Aug., 1960).

It is shown that the effects of thermal expansion of the grating and sine drive in a monochromator can be made to cancel exactly by proper mounting of the drive screw, and by choosing the material of the drive arm such that its thermal coefficient of expansion just equals the sum of the coefficients of the grating and drive screw.

535.33

14831 AN ESTIMATE OF THE ERROR IN INTERPOLATION ALONG THE NORMALS OF THE SPECTRUM INTERVALS LYING ON ROWLAND'S CIRCLE. V.A.Loginov.

Optika i Spektrosk., Vol. 8, No. 3, 382-5 (March, 1960). In Russian.

Discusses interpolation along the normals of spectrum intervals lying on Rowland's circle, using the assumptions of the theory of interpolation of functions and estimates of the error committed by replacement of a given function by a Lagrange polynomial. Results are obtained for the special case of a DFS-2 spectrograph from which one can find the spectral intervals along which linear and quadratic interpolations can be employed. A.Tybulewicz

535.33

14832 COMPENSATION OF ROWLAND'S "GHOSTS" IN SPECTROGRAPHS WITH DOUBLE DIFFRACTION AT THE GRATING. V.N.Karpinskii.

Optika i Spektrosk., Vol. 8, No. 3, 401-3 (March, 1960). In Russian.

A plane mirror M was used to reflect back a diffracted ray onto the grating in order to produce a second diffraction. When the angle between the diffracted ray incident on the mirror and the same ray reflected from M was 0.5°, the maxima and minima of ghosts became blurred, since the distortions of the wavefronts produced on first diffraction were reflected back to the grating with a period different from that of the original distortions produced by the grating. The ghosts can be compensated also by a system of two plane mirrors joined so that their planes are normal to each other, as suggested by Walsh (Abstr. 6847 of 1951). A.Tybulewicz

535.33 : 539.1.07

14833 EFFICIENCY, STABILITY, AND CHARACTERISTICS OF PHOTOSENSITIVE G.M.COUNTERS. K.W.Ostrowski.
Acta phys. Polon., Vol. 18, No. 3, 231-53 (1959).

Presents the results of investigations of photosensitive counters used in direct reading spectrometry. Stable photosensitive counters constructed from metal with a cathode in the form of a strip set into the counter tube are described. The method used to measure the photoelectric efficiency is based on the known spectral distribution of an ultraviolet standard and the transmission of a UCII 22 spectrograph. Counters with a platinum cathode proved to be the most stable. The variation of the photoelectric efficiency of G.M. counters was investigated. Three types of change are discussed. (a) Initial changes leading to a stable photoelectric threshold and a stable photoelectric efficiency. In order to obtain this, about 10^6 counts are necessary. (b) Reversible changes in efficiency of short duration are observed above a certain counting rate. These depend on the counting rate and the wavelength, and occur with a certain delay. (c) Changes in the photoelectric efficiency connected with the ageing of the counter. These changes involve a slow increase in the efficiency and a shift of the photoelectric threshold in the direction of the longer waves. They were absent only in counters with a platinum cathode. A relation between the slope of the characteristics for ultraviolet radiation and the photoelectric efficiency has been found: slopes between 5-55% per 100 V correspond to efficiencies between 10^{-3} and 10^{-10}.

535.33

14834 CONTROLLED ATMOSPHERE EXCITATION CHAMBER FOR D.C. ARC ANALYSIS. M.P.Brash and J.P.Phaneuf.
Appl. Spectrosc., Vol. 14, No. 3, 80-1 (June, 1960).

Cyanogen interference in d.c. arc spectroscopy between carbon electrodes is eliminated by means of a nitrogen-free controlled atmosphere. The excitation chamber is described and specimen spectrograms presented. G.I.W.Llewelyn

535.33

14835 INTENSE LIGHT SOURCES FOR THE VACUUM ULTRAVIOLET. II. E.W.Schlag and F.J.Comes.
J. Opt. Soc. Amer., Vol. 50, No. 9, 866-7 (Sept., 1960).

For Pt I, see Z. phys. Chem. (Frankfurt), Vol. 21, 212 (1959). An intense light source for the vacuum ultraviolet using a microwave energy source is described and compared to results achieved from an a.c. discharge.

535.33

14836 STABILIZED HIGH-INTENSITY LIGHT SOURCE. C.M.Hurd.
J. sci. Instrum., Vol. 37, No. 8, 305-6 (Aug., 1960).

The positions of the electrodes in a carbon arc are held constant to 0.005 cm by photoelectric control and the polarity is automatically reversed when the intensity changes by 2%. Stability of 4% for fluctuations slower than 2 sec is claimed. W.T.Welford

535.33 : 534.22

TEMPERATURE MEASUREMENTS OF SHOCK WAVES BY SPECTRUM-LINE REVERSAL. See Abstr. 14732

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics, Liquid State, or Gaseous State)

535.4

14837 DISCOVERY OF INTERFERENCE BY THOMAS YOUNG. R.W.Pohl.
Amer. J. Phys., Vol. 28, No. 6, 530-2 (Sept., 1960).

Thomas Young contributed to philology and to the problems of vision, as well as to the understanding of wave motion and interference for which he is principally known. The steps by which he achieved understanding of the phenomena of interference, from his first work in 1801, through the publication of Course of Lectures on Natural Philosophy, and up to his development of the theory of the interferometer in 1817, are outlined.

535.4

14838 THE THEORY OF MULTILAYERS CONSISTING OF WEAKLY ABSORBING MATERIALS AND THEIR USE AS INTERFEROMETER MIRRORS. G.Koppelmann.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 7-8, 388-96 (1960).
In German.

With the aid of matrix methods the absorption of quarter wave and half wave dielectric multilayers is computed for materials of low absorption. The influence of absorption on the practical use o the multilayers for interferometers is discussed. Half-widths and transmissions are computed for a Fabry—Perot interferometer using multilayers. S.Tolansk

535.

14839 PHASE SHIFT EFFECTS IN FABRY—PEROT INTERFEROMETRY. C.J.Koester.
J. Res. Nat. Bur. Stand., Vol. 64A, No. 3, 191-200 (May-June, 196

A method is demonstrated for utilizing in Fabry—Perot interferometry the data on reflection phase shift dispersion obtained fr fringes of equal chromatic order. Unknown wavelengths can be calculated from the Fabry—Perot patterns obtained with a large etalon spacing, even without prior knowledge of the phase shift of the reflecting surfaces. When the theoretical phase shift as a func of wavelength is known approximately, then the correct orders of interference can be determined for both the Fabry—Perot fringes and fringes of equal chromatic order. From the wavelengths of th latter the phase shift dispersion can be measured to an accuracy o about 10 A. The method is especially useful for reflectors with large dispersion of phase shift, such as multilayers. Results in th visible spectrum are reported for aluminium films and a pair of dielectric 15 layer broadband reflectors.

535.4

14840 COMPARISON OF RAYLEIGH AND JAMIN INTERFEROMETERS. Yu.V.Kolomiitsov.
Optika i Spektrosk., Vol. 8, No. 5, 702-12 (May, 1960). In Russian.

Considers conditions necessary for transformation of Jamin interferometers into Rayleigh-type instruments and shows that the dependence of the interference-fringe contrast on dimensions of th light source and on other factors is given by the same law for Rayleigh and Jamin interferometers. The treatment assumes that two diffraction images of each point in the light source are superimposed exactly on one another. The contrast law is used to make some modifications in the theory of Rayleigh interferometers and t deduce recommendations for the adjustment of Jamin interferometers. A.Tybulewic

535.4

14841 MULTILAYER FILTER SYSTEMS USED IN THE INFRARED. M.Barchewitz and M.Gautier.
Onde elect., Vol. 39, 845-53 (Nov., 1959). In French.

Review, giving the theory of interference filters, and the infra red transmission of various forms of filter. It is shown that the characteristics of a filter can be deduced by considering it as a transmission line. C.Hilsu

535.4

14842 FRESNEL DIFFRACTION AT THE EDGE OF A SEMI-TRANSPARENT PHASE-RETARDING SCREEN.
N.Marchand, J.Faget and C.Fert.
C.R. Acad. Sci. (Paris), Vol. 250, No. 25, 4135-7 (June 20, 1960).
In French.

The use of the Cornu spiral for rapid graphical determination of the diffraction effects is explained. W.T.Welfor

535.4

14843 AN INVESTIGATION OF ABERRATIONS OF A CONCAV GRATING. A.I.Kozlenkov.
Optika i Spektrosk., Vol. 8, No. 5, 692-701 (May, 1960). In Russian

Uses Beutler's method (Abstr. 2949 of 1945) in an investigation of the geometrical form of the focus near the Rowland circle, estab lishes the dependence of the focus characteristics on the errors of adjustment, obtains an expression for the aberrations when such errors occur and gives a simple method for calculation of the resolving power. A.Tybulewic

535.4

14844 MOIRÉ FRINGE READING HEAD FOR USE WITH A FINE GRATING. D.A.Palmer.
J. sci. Instrum., Vol. 37, No. 8, 261-2 (Aug., 1960).

In the usual moiré fringe measuring system, practical difficulties arise in the use of very fine gratings. An optical system is described in which the use of a separate index grating is avoided, the moiré fringes being formed between the scale grating and the image formed by its reflection in a concave mirror. This arrangement has the particular advantage that the sensitivity is doubled. A working model has been constructed to demonstrate the principle

535.42 : 534.21

14845 DIFFRACTION OF LIGHT BY ULTRASONIC WAVES.
R.R.Aggarwal.

Phys. Radium, Vol. 20, No. 10, 1812-15 (Oct., 1959). In French.

The intensity of the diffraction lines was calculated using a thod of successive approximation on the assumption that the fraction pattern contained only a limited number of diffraction es. The identity of most of the results obtained by others through orious methods is established. The method has the advantage it if can be generalised easily; the accuracy being increased "back substitution". It is shown that as the angle of incidence varied the intensity of a particular diffraction line attains a incipal maximum at the corresponding Bragg reflection angle d secondary maxima at the Bragg reflection angles corresponding the other orders.

535.43

14846 SCATTERING OF LIGHT IN MEDIA WITH VARIABLE OPTICAL PARAMETERS. A.P.Ivanov and É.B.Khobos

tika i Spektrosk., Vol. 8, No. 4, 556-62 (April, 1960). In Russian.

Describes two methods of calculating the reflection and insmission coefficients of light-scattering layers in which the attering and absorption parameters vary with thickness. The flection spectra obtained experimentally for mixtures of powdered loured glasses agreed with the theoretical results. The absorption efficient of these glasses varied linearly with the layer thickness.

A.Tybulewicz

535.43

14847 INTENSITY OF BRILLOUIN COMPONENTS IN LIGHT SCATTERED BY SOME LIQUIDS K.C.Medhi.

dian J. Phys., Vol. 33, No. 3, 135-8 (March, 1959).

The Brillouin components in light scattered by water and acetone ve been recorded using an experimental arrangement in which stray ght was avoided very carefully. It is observed that the intensities the Brillouin components relative to those of the central components are in agreement with those predicted by the theory of Landau d Placzek (1934).

535.43

14848 APPARATUS FOR MEASURING THE SPECTRAL DEPENDENCE OF LIGHT SCATTERING FROM LARGE ARTICLES. F.S.Brackett and E.Charney.

Opt. Soc. Amer., Vol. 50, No. 8, 811-12 (Aug., 1960).

A micro device is described which takes advantage of the ecial feature of a dark-field microscope condenser which permits llection of light from the entire annulus, thus providing sufficient ergy for the measurement of scattering with good spectral solution.

535.43

14849 COMPARISON OF THE FUNCTIONS REPRESENTING SCATTERING OF LIGHT BY SPHERICAL PARTICLES.
u.V.Mal'tsev.

ptika i Spektrosk., Vol. 8, No. 5, 686-91 (May, 1960). In Russian.

Discusses the accuracy and the limits of applicability of various neralized parameters used for graphical representation of scatring functions in such a way that the positions of the corresponding trema of different functions coincide. Suggests a new parameter hich can be used to calculated positions of the extrema without owing anything about the nature of the relative scattering functions.

A.Tybulewicz

535.43

14850 A CONTRIBUTION TO THE THEORY OF LIGHT SCATTERING BY SYSTEMS OF PARTICLES.
.Ciobanu and E.Toma.

ev. de Physique (Bucarest), Vol. 4, No. 4, 475-87 (1959). German.

Distances between the particles were assumed to be of the der of one wavelength of light and interactions between the light attered by different particles, as well as multiple scattering, were ken into account. By applying the self-consistent field method, a ystem of integro-differential equations for the scattered field was otained; this was solved in terms of the scattering function of a ngle particle by a power series expansion.

W.T.Welford

535.43

14851 THE ANGULAR DISTRIBUTION OF LIGHT SCATTERED BY A SYSTEM OF COPOLYMERS.
I.Benoit and C.Wippler.

Chim. phys., Vol. 57, No. 6, 524-7 (1960). In French.

Rayleigh scattering formulae are obtained assuming two components of given refractive increments and a Gaussian distribution of distances between scattering centres in the macromolecule. Terms occur corresponding to each component and in addition there is a cross-term.

W.T.Welford

535.51

14852 THE WIRE GRID AS A NEAR-INFRARED POLARIZER.
G.R.Bird and M.Parrish, Jr.

J. Opt. Soc. Amer., Vol. 50, No. 9, 886-91 (Sept., 1960).

Wire girds have been fabricated with microscopic elements and periodicity. These wire grids behave as linear polarizers over large portions of the i.r. spectrum, confirming predictions from electromagnetic theory. The method of fabrication of grids with periods as small as 463 mμ is described. Limits on the performance of a wire-grid polarizer are set by fineness of period, optical constants of the metal, spectral transmission of the supporting substrate, and by skin-depth effects. Within these limits, excellent polarizer performance may be obtained over a very wide band of wavelengths, and these new wire-grid polarizers do, in fact, cover the range 2-15 μ and beyond. Appreciable polarization is observed at near-infrared and visible wavelengths. Wire grids may be used in convergent beams of radiation or in restricted geometrical arrangements, unlike many pile-of-plate or prism polarizers. These wire-grid polarizers have proved useful in measuring the imperfections of other types of infrared polarizers.

535.51

14853 PREPARATION OF SELENIUM POLARIZERS FOR THE NEAR INFRARED REGION. K.Buijs.

Appl. Spectrosc., Vol. 14, No. 3, 81-2 (June, 1960).

A formvar film of 0.3μ thickness is used as a support for the selenium film for use in infrared transmission polarizers. Details of preparation and preservation are given.

G.I.W.Llewelyn

535.51

14854 ACCURATE MEASUREMENTS OF PHASE DIFFERENCES WITH THE BABINET COMPENSATOR.
P.Hariharan and D.Sen.

J. sci. Instrum., Vol. 37, No. 8, 278-81 (Aug., 1960).

A considerable increase in accuracy is possible in measurements of phase differences with a Babinet compensator by reflecting the beams emerging from the compensator back through it. A new system of fringes produced in this fashion is described, in which the intensity distribution undergoes a periodic modulation as the path difference introduced by the compensator is varied; it is shown that the Babinet compensator can be converted into a uniform-field compensator by reflecting the beams emerging from the compensator back through it. By using a suitable half-shade device with such an arrangement, readings can be repeated to a few ten-thousandths of a wavelength.

535.51

14855 ANALYSIS OF ELLIPTICALLY POLARIZED LIGHT.
R.C.Plumb.

J. Opt. Soc. Amer., Vol. 50, No. 9, 892-4 (Sept., 1960).

Exact equations for the analysis of elliptically polarized light with a nonexact quarter-wave compensator are developed. Procedures are described for calibrating a quarter-wave compensator.

535.51

14856 STUDY OF THE STATE OF POLARIZATION OF A DISTURBANCE IN THE RARER MEDIUM IN TOTAL INTERNAL REFLECTION, USING SCATTERING PARTICLES.
R.Fleischmann and R.Witt.

Z. Phys., Vol. 159, No. 3, 360-8 (1960). In German.

The ellipticity of light scattered from carbon particles deposited as soot on the hypotenuse of a prism was determined by means of a Sénarmont compensator, the light incident inside the prism being plane polarized. The results agreed well with theoretical predictions, assuming Rayleigh scattering from the soot.

W.T.Welford

COLORIMETRY . PHOTOGRAPHY

535.62

14857 NEW PIGMENT-MIXTURE DATA.
E.Friel.
J. Opt. Soc. Amer., Vol. 50, No. 8, 791-801 (Aug., 1960).

Information about the colours resulting from mixture of the pigments described in Abstr. 188 of 1960 at lightnesses 7, 5, 3, and 1 of the same scale is presented. It is shown that by using different positions for some pigments at different lightnesses, information about the colours resulting from mixture of the pigments at these lightnesses also can be summarized very well in graphic form. A technique for assembling the pigment positions for all the given lightnesses on a single diagram is introduced.

535.64

14858 MECHANIZED CONVERSION OF COLORIMETRIC DATA TO MUNSELL RENOTATIONS.
W.C.Rheinboldt and J.P.Menard.
J. Opt. Soc. Amer., Vol. 50, No. 8, 802-7 (Aug., 1960).

A programme for a high-speed digital electronic computer is described for performing the computation of the Munsell renotations H,V,C corresponding to given CIE chromaticity coordinates x,y and daylight reflectance Y. Mathematically, this is equivalent to a three-dimensional coordinate transformation where two of the three transformation functions are given only numerically for a grid of discrete points. Since this grid consists of approximately 5000 points which are nonuniformly spaced, the major problem was to devise an economic scanning routine in order to find the point used in the interpolation. This was accomplished by consistent use of vector algebra and the help of an interpretive routine for vector operations.

77

14859 IMPROVED DESIGN FOR AN AUTO-FOCUS RANGE-FINDER. H.Asher, L.Dodin and H.P.Mulholland.
J. sci. Instrum., Vol. 37, No. 9, 356-7 (Sept., 1960).

Various designs for a camera range-finder with parallel mirrors and a variable prism unit have been described (Abstr. 1485 of 1953; 1136 of 1954). In each design certain parts of the range-finder shared the motion of the camera lens in focusing. Here a further design of this type is described in which there is no relative movement of the mirrors.

77

14860 A SIMPLE METHOD FOR DETERMINATION OF THE RESOLUTION OF PHOTOGRAPHIC FILMS. E.F.Pócza.
Acta phys. Hungar., Vol. 8, No. 1-2, 241-4 (1957). In German.

A grating of 44-80 lines/cm. having in its Fourier series analysis high harmonics of relatively large amplitude, is used in contact with the film. Examination of the developed film as an optical grating enables the reproduction of these components to be measured and the resolution thereby to be estimated.

G.F.J.Garlick

77 : 539.2

14861 THE FORMATION OF EXCITONS IN AgBr BY THE PASSAGE OF AN IONIZING PARTICLE. J.Lory.
C.R.Acad.Sci. (Paris), Vol. 250, No. 22, 3622-3 (May 30, 1960). In French.

Discrepancies between the low theoretical value of the number of developable grains in a silver bromide emulsion due to incident fast electrons and the number found experimentally prompted a new appraisal of latent-image formation. It is suggested that excited states of bromine ions have large orbitals with weak binding which may lead to exciton dissociation providing free electrons and holes to the latent-image process.

G.F.J.Garlick

77 : 535.2

SIMPLE CONTINUOUS CHART AND INTEGRATING DEVICE FOR A JOYCE—LOEBL MICRODENSITOMETER Mk. I. See Abstr. 14782

HEAT . RADIATION

536 :

THERMIONIC THERMAL—ELECTRICAL ENERGY CONVERTERS. See Abstr 14935

53

14862 THE SOLUTION OF THE CONVERSE OF STEFAN'S PROBLEM IN THE CASE OF SPHERICAL SYMMETR
G.A.Martȳnov.
Zh. tekh. Fiz., Vol. 30, No. 2, 239-41 (Feb., 1960). In Russian.

The solution of the converse problem for a variety of initial conditions and different laws of motion for the boundary between two phases should lead to at least a qualitative solution of the dir problem. Two laws of motion are considered. For the first, whe the radius of the interface is given by $R(t) = R(0) + v\sqrt{t}$, the gener solution is obtained; for the second, $R(t) = R(0) + vt$, it is shown t reduce to an integral equation whose solution was found earlier (Abstr. 3194 of 1957).

G.A.Chisn

53

14863 ON THE NUMERICAL TREATMENT OF HEAT CONDUCTION PROBLEMS WITH MIXED BOUNDARY CONDITIONS. A.N.Lowan.
Math. Comput., Vol. 14, 266-9 (July, 1960).

The two-dimensional problem of heat conduction in a rectang where the temperature is prescribed over a portion of the bounda while the temperature gradient is prescribed over the remainder the boundary, may be treated numerically by replacing the differential equation of heat conduction and the equations expressing the given initial and boundary conditions by their difference analogues and solving the resulting system. It is shown that if the scheme is to be stable the intervals Δx and Δy must be chosen so that $k\Delta t/(\Delta x)^2 + k\Delta t/(\Delta y)^2 \leq \frac{1}{2}$.

536

14864 THE CALCULATION OF NON-STATIONARY TEMPER TURE DISTRIBUTIONS IN STRATIFIED MEDIA WITH ELECTRONIC ANALOGUE COMPUTERS.
E.Deeg and I.Hertweck-Crone.
Z. angew. Phys., Vol. 12, No. 4, 184-90 (April, 1960). In German.

The problem arises in the manufacture of glassware by moulding in iron moulds. The general equations relating mould an glass thickness "thermal conductivities and temperatures" and time are derived. The simulation of the system is illustrated and discussed in some detail with numerical and graphical results for typical mould dimensions.

K.C.Garn

536

14865 AN EVALUATION METHOD FOR NON-STATIONARY DIFFUSIVITY AND THERMAL CONDUCTIVITY MEASUREMENTS. H.Tautz.
Exper. Tech. der Phys., Vol. 8, No. 1, 34-7 (1960). In German.

A graphical method for use with the equation $\partial T/\partial t = a\nabla^2 T$ is described and the appropriate values to be used with the curves for various shapes of bodies are listed. A polyvinylchloride rod cooled to 0°C and then immersed in boiling water is treated as an example. The values 1.174×10^{-7} m^2 sec^{-1} and 0.146 kcal m^{-1} hr^{-1} deg^{-1} are obtained for a and the thermal conductivity respectively.

S.Weintrou

536

14866 CIRCULAR CYLINDER UNDER PERIODIC FLUCTUATIONS OF TEMPERATURE. V.Vodička.
Z. angew. Math. Phys., Vol. 8, No. 1, 53-64 (1957).

Gives general results for heat waves in homogeneous isotropi cylindrical bodies in periodic temperature fields. See also followi abstract.

536

14867 A METHOD FOR CALCULATING THE QUASISTATIONARY CHANGE OF TEMPERATURE WITH A CONTROLLED HEAT CONDUCTION PROCESS IN A SOLID BODY.
H.Jäckel.
Z. angew. Math. Phys., Vol. 10, No. 2, 133-42 (1959). In German.

In the preceding abstract a special problem of heat conduction with local and time-dependent boundary conditions was solved. As the method does not seem very suitable for solving problems of this kind, the solution for the most general case has been determined. As an example the problem treated by Vodička has been solved, and the equivalence of both results is shown.

536.2 : 539.17

14868 HEAT TRANSFER TO WATER FLOWING PARALLEL TO TUBE BUNDLES. J.Weisman.

clear Sci. Engng., Vol. 6, No. 1, 78-9 (July, 1959).

The results of measurements of the heat transfer coefficient for ter flowing parallel to bundles of tubes have been analysed. It s assumed that the usual modified form of Colburn's equation plied, but that the multiplying constant depended on the ratio of e distance between the tube centres to the tube diameter. A ear variation was found but differs in the cases of squared and iangular pitches between the rods. However, if the constant is aluated as a function of the ratio of water flow area to total cross-ction area a linear relation is still found but is independent of the ometry of lattice. J.F.Hill

536.2 : 539.17

HEAT TRANSFER IN A CROSS FLOW NUCLEAR REACTOR.

e Abstr. 13357

536.2

14869 TURBULENT LIQUID-METAL HEAT TRANSFER IN CHANNELS. H.F.Poppendiek.

uclear Sci. Engng, Vol. 5, No. 6, 390-404 (June, 1959).

An analytical heat transfer solution is derived and evaluated r the general case of a turbulently flowing liquid metal which uddenly encounters a step-function boundary temperature in a channel system. Local Nusselt moduli, dimensionless mixed-mean fluid emperatures, and arithmetic-mean Nusselt moduli are given as functions of Reynolds and Prandtl moduli and a dimensionless axial-istance modulus. These solutions are compared with known solutions of more specific systems as well as with a set of experimental iquid-metal heat transfer data for a thermal entrance region. The esults of this study can be used to define the temperature structure nd heat transfer in solid-fuel element reactor cores and accelerator argets that are being cooled by liquid metals.

536.2

14870 THE EXPERIMENTAL CHOICE OF SPECIFIC PARAMETERS FOR A FLUID IN HEAT EXCHANGE BY ONVECTION. J.Fauré and J.P.Leroux.

.R.Acad. Sci. (Paris), Vol. 250, No. 22, 3602-4 (May 30, 1960). n French.

The values of α as a function of T_s obtained with the apparatus escribed in Abstr. 5207 of 1960 were used to examine graphically hether, if $\alpha = KV^{0.8}$ for all values of T_s a temperature T, related o T_s and T_e, can be found such that $Nu = KRe^{0.8}$, in which the therm-l conductivity and viscosity correspond to T. α is the local co-fficient of convection, T_s the surface temperature of the heated ody, V the air velocity and T_e the temperature of flow. It appears hat $T = \frac{1}{2}(T_e + T_s)$, called in the United Kingdom, "the film temper-ture", and that therefore T is of importance in the mechanism of onvection. S.Weintroub

536.2

14871 EXPERIMENTAL STUDY OF THE INFLUENCE OF THE ENTRY OF AIR ON THE LOCAL COEFFICIENT OF CONVECTION IN AN ANNULAR SPACE. H.Cordier and O.Houseaux.

C.R.Acad. Sci. (Paris), Vol. 250, No. 23, 3795-7 (June 8, 1960). In French.

The arrangement consisted of a 30 mm diameter heated cylinder, with a hemispherical nose O and maintained at a constant temperature, inside a coaxial open-ended trumpet shaped cylinder of 54 mm diameter. The distance d between O and the plane where the outer cylinder commenced to widen could be varied, and the coefficient of convection α was measured at a point 24 cm from O and away from the open trumpet end for various speeds of air at atmospheric pressure through the annular space. The results are shown graphically. Both the geometry of the arrangement i.e., d and the change from laminar to turbulent flow, affect α. S.Weintroub

536.2

14872 HEAT TRANSFER OF COMBINED FREE AND FORCED CONVECTION IN CIRCULAR AND SECTOR TUBES.

L.N.Tao.

Appl. sci. Res. A, Vol. 9, No. 5, 357-68 (1960).

The heat transfer problems of combined free and forced convection by a fully developed laminar flow in a vertical tube and a vertical sector channel of linear axial wall temperature gradient with and without heat generation are treated. By means of a complex function, the coupled momentum and energy equations are combined in the form of a wave equation in the complex domain. Exact solutions are then established in terms of Bessel and associated functions. Some numerical calculations and discussions are also included.

536.2 : 538.3

STEADY AND TRANSIENT FREE CONVECTION OF AN ELECTRICALLY CONDUCTING FLUID FROM A VERTICAL PLATE IN THE PRESENCE OF A MAGNETIC FIELD. See Abstr. 15123

536.2

14873 LOCAL PRESSURE GRADIENTS IN FORCED CONVECTION VAPORIZATION. V.E.Schrock and L.M.Grossman.

Nuclear Sci. Engng, Vol. 6, No. 3, 245-50 (Sept., 1959).

An experimental study of pressure drop in forced convection vaporization has been made in a heat transfer loop designed for the investigation of local heat transfer coefficients and local pressure gradients for water flowing vertically upward in an electrically heated tube. Data presented are for $\frac{1}{8}$ in. i.d. 347 stainless steel tubes of 15 and 20 in. lengths with mass fluxes of 200 to 700 lb per sec per ft^2, heat fluxes of 1 to 8 × 10^5 Btu. hr^{-1}-ft^{-2}, qualities at the exit up to 50% and with pressures ranging from 50 to 400 psia. A correlation of the local pressure gradients as a function of the Martinelli parameter X_{tt} has been obtained to within ± 15% and a design procedure for calculating over-all pressure drop from this correlation is suggested.

536.3

14874 LOW-TEMPERATURE, DIRECTIONAL, SPECTRAL EMISSIVITY OF TRANSLUCENT SOLIDS. D.Weber.

J. Opt. Soc. Amer., Vol. 50, No. 8, 808-10 (Aug., 1960).

The principles outlined in Abstr. 9367 of 1959 have been extended to translucent materials by use of the generalization of Kirchhoff's law derived by McMahon. Several methods are described by which spectral emissivities may be measured, depending upon the experimental arrangement desired.

536.3

14875 THERMO-OPTICAL PROPERTIES OF GOLD AND PLATINUM. U.Schley, C.Tingwaldt and J.Verch.

Naturwissenschaften, Vol. 47, No. 10, 222-3 (1960). In German.

For metals at some particular wavelength (the X-point), the emissivity is independent of temperature. The X-point behaviour is investigated for gold and platinum and the experimental results are interpreted in accordance with the free-electron properties of metals. C.A.Hogarth

536.3 : 536.2

14876 SPECTRAL EMISSIVITY, TOTAL EMISSIVITY, AND THERMAL CONDUCTIVITY OF MOLYBDENUM, TANTALUM, AND TUNGSTEN ABOVE 2300°K.

R.D.Allen, L.F.Glasier, Jr and P.L.Jordan.

J. appl. Phys., Vol. 31, No. 8, 1382-7 (Aug., 1960).

The emissivities and thermal conductivities of high purity arc melted molybdenum and tantalum and powder metallurgy tantalum and tungsten were measured between 2300°K and their respective melting points. A method is presented for the determination of spectral and total emissivities from the determination of brightness temperature at the centre of an electrically heated rod as a function of heat flow rate. The method does not depend on the experimental achievement of blackbody conditions. Spectral emissivities were also determined by measurement of brightness temperatures at the respective melting points. Thermal conductivities of electrically heated rods were determined by the Jain and Krishnan longitudinal heat flow method. The spectral emissivities of tantalum and tungsten decrease linearly with increase in temperature. The spectral emissivities of tantalum and tungsten decrease linearly with increase in temperature. The spectral emissivity of molybdenum is constant. The total emissivities of molybdenum, tantalum, and tungsten increase with increasing temperature. For any of the metals the the spectral and total emissivities are closest to each other at the melting point. The melting point of tantalum is significantly lowered by small increase in impurity content. The thermal conductivities of molybdenum, tantalum, and tungsten decrease linearly with increasing temperature. The ranges of spectral emissivity, total emissivity, and thermal conductivity above 2300°K are as follows:

	ϵ_λ	ϵ_T	K (cal cm^{-1} sec^{-1} ^{0}K^{-1})
Mo	0.30	0.271-0.285	0.34-0.32
Ta	0.361-0.350	0.288-0.324	0.15-0.11
W	0.37-0.36	0.268-0.352	0.38-0.30

536.3

14877 EFFECT OF SPECULAR REFLEXIONS ON THE RADIATION FLUX FROM A HEATED TUBE.

K.S.Krishnan.
Nature (London), Vol. 187, 135 (July 9, 1960).

Discusses the case where the fraction, $(1-\epsilon)$, of the radiation incident on a surface that is returned to the enclosure is specularly reflected. A formula is given for the flux from the mouth of a cylinder, open at both ends. For $L \to \infty$ (where L is the cylinder length) this is independent of emissivity and is equal to that from a black body of the same area as the cross-section of the tube. A formula is given for the case of the other end closed, and as an example, for $\epsilon = 0.75$ and $L = 5D$ (where D is the cylinder diameter) the flux is found to be about 1% less than for a black body. For perfectly diffuse reflection of this fraction (0.25), the total flux over all directions is considerably less than for a black body, and remains so for any cylinder length. R.Berman

536.3

14878 ENERGY DETECTABLE BY RADIATION DETECTORS.

R.C.Jones.
J. Opt. Soc. Amer., Vol. 50, No. 9, 883-6 (Sept., 1960).

It is customary to evaluate the detecting ability of radiation detectors by stating the noise equivalent input power, or its reciprocal the detectivity, as a function of the modulation frequency. The statement is often given in terms of the detectivity D^*, which is the reciprocal of the noise equivalent power referred to unit bandwidth and unit area. The difference between noise equivalent energy and noise equivalent power is more than a mere division or multiplication by time, because the noise equivalent power is usually given as a function of the modulation frequency of the radiation, whereas the noise equivalent energy must be given in terms of a pulse of radiation. The statement of the noise equivalent energy is given in terms of the energy detectivity Δ^*, which is the reciprocal of the noise equivalent energy referred to unit area of the detector. It is shown that the maximum possible energy detectivity is given by

$$\Delta_m^* = 2 \int_0^\infty [\, D^*(f)]^2 df \;^{1/2} .$$

This energy detectivity is, in fact, achieved if the radiation pulse is very short, and if the gain of the associated amplifier is suitably matched to the properties of the detector.

536.3 : 518

14879 NOMOGRAPHIC-TYPE SLIDE RULE FOR OBTAINING SPECTRAL BLACKBODY RADIATION DIRECTLY.

C.D.Reid.
Rev. sci. Instrum., Vol. 31, No. 8, 886-90 (Aug., 1960).

A nomographic type of slide rule is described from which spectral radiant emittance can be obtained directly and from which the exponential power at which the spectral radiant emittance is changing with temperature for any value of wavelength and temperature can be read. The usual quantities available on radiation slide rules are also obtainable.

536.3

14880 DEPENDENCE ON ATMOSPHERIC PRESSURE OF THE RESPONSE CHARACTERISTICS OF THERMOPILE RADIANT ENERGY DETECTORS.

A.R.Karoli, A.K.Ångström and A.J.Drummond.
J. Opt. Soc. Amer., Vol. 50, No. 8, 758-63 (Aug., 1960).

An account is given of an investigation into the pressure dependence of the sensitivity (i.e., responsivity) of 10 different types of thermopile detector over the pressure range 760 to 10^{-5} mm. The study is confined to those forms of thermopile commonly used for the measurement of unmodulated solar and infrared radiation. The radiation intensity-thermopile e.m.f. relationship at reduced ambient pressures is discussed as is also the change introduced into the response time constant. It is demonstrated that the results for the different instruments are in agreement, generally, with what is derived from the fundamental laws governing energy transfer within radiometric devices.

536.3 : 621.383

14881 THE BEHAVIOR OF INFRARED DETECTION ELEMENTS UNDER NUCLEAR RADIATION EXPOSURE.

E.W.Kutzscher.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1520-1 (Sept., 1959).

Infrared detectors were bombarded with neutrons and γ radiation PbS, PbTe and InSb photocells showed no change in properties when γ radiation at a strength of 20 000 r/hr was incident, but gold-doped germanium photoconductive cells showed a considerable increase in noise level during the exposure. Similar results were obtained for neutron bombardment. In PbS cells exposed to doses of more than 10^7 r, changes occurred which lasted for one month after exposure. C.Hilsu

536.3 : 621.383 : 621.375.1

14882 PREAMPLIFIERS FOR NON-IMAGE-FORMING INFRARED SYSTEMS.

J.A.Jamieson.
Proc. Inst. Radio Engrs, Vol. 147, No. 9, 1522-3 (Sept., 1959).

The components, circuits and construction techniques for valv and transistor preamplifiers are briefly discussed. C.Hilsu

536.3 : 621.383 : 621.375

14883 DETECTIVITY AND PREAMPLIFIER CONSIDERATIO FOR INDIUM ANTIMONIDE PHOTOVOLTAIC DETECTORS.

G.R.Pruett and R.L.Petritz.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1524-9 (Sept., 1959).

To obtain maximum performance from these detectors certain conditions must be fulfilled by the preamplifier. Details are given of a transistor preamplifier which can satisfy these conditions. Some experimental results are included. C.Hilsu

536.3 : 621.396.969.

14884 METHODS OF BACKGROUND DESCRIPTION AND THEI UTILITY.

D.Z.Robinson.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1554-61 (Sept., 1959).

The characteristics of the background against which a potentia target appears is an important consideration in the design of infrar detection systems. A survey is made of the present methods of describing backgrounds. The backgrounds are classified into vario types and the use of the proposed descriptions for each type is examined. It is concluded that the autocorrelation function and the Wiener transform are good means for describing a Gaussian background ensemble, but for non-Gaussian ensembles, such as cloudy skies, these functions give no indication of peak noise signal. The use of the probability distribution of radiance is recommended for non-Gaussian ensembles. C.Hilsu

536.3 : 621.396.969.3

14885 SPECIAL ELECTRONIC CIRCUITS FOR THE NON-IMAG FORMING INFRARED SYSTEMS.

J.A.Jamieson.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1570-2 (Sept., 1959).

A description of three circuits which are used in infrared detection systems to improve the s/n ratio. They are: (a) a filter wit a response matching the time dependence of the expected signal; (b) a system for rejecting background signals; and (c) a circuit whic can detect the appearance of an additional target. C.Hilsun

536.3 : 621.396.969.

14886 SIMULATION OF INFRARED SYSTEMS.

H.F.Meissinger.
Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1586-92 (Sept., 1959).

Theoretical analysis of infrared tracking systems can be suppl mented by studies using simulated targets. Simulation techniques can be classified as mathematical or physical, and may involve typically the representation of the complete system in terms of mathematical relations which can be programmed on a computer, the introduction of an electrical signal into the amplifier chain, or the provision of an artificial source of infrared radiation. A survey is given of such techniques, and their application is considered in detail. C.Hilsun

536.4

14887 ON SPECIFIC HEAT JUMPS IN RELATION TO MELTING POINT FORMULAE.

M.P.Mokhnatkin.
Zh. tekh. Fiz., Vol. 30, No. 2, 248 (Feb., 1960). In Russian.

Derives ΔC_p for the melting equation given by $dP/dT = 2(P + a)/T$ as discussed by Voronel' (Abstr. 10941 of 1959). R.Berma

536.42 : 539.1

14888 INTERACTION OF CONDENSABLE GASES WITH COLD SURFACES.

G.W.Sears and J.W.Cahn.
J. chem. Phys., Vol. 33, No. 2, 494-8 (Aug., 1960).

Deposition from a molecular beam onto a cold target surface only occurs when the beam pressure is many orders of magnitude larger than the vapour pressure of the depositing phase at the substrate temperature. The critical beam pressure for deposition has been interpreted as a critical supersaturation for heterogenous nucleation of a condensed phase. It is shown that the critical beam ssure is much too large to be accounted for as a critical value nucleation if the adsorbate temperature and the substrate nperature are alike. The interpretation of critical deposition enomena as a nucleation event must include the additional assump- n that the adsorbate temperature is somewhat higher than the bstrate temperature.

536.42

14889 THE RAPID CHANGE OF CONCENTRATION IN THE CASE OF SLOW EVAPORATION OF A MIXTURE.

Ya. Kucherov and L.É.Rikenglaz.
. eksper. teor. Fiz., Vol. 37, No. 6(12), 1821-2 (Dec., 1959). Russian.

The authors derive formulae for determining the concentration, nperature and pressure in gaseous phase for slow evaporation of nixture, assuming that (1) the evaporation rate is small compared th that in vacuo; (2) the molecules of all components of the mixture e monatomic; (3) the coefficients of condensation and accommo- tion are equal to unity; and (4) the ideal gas laws apply to the pour. The method of derivation is analogous to that described in earlier paper (Abstr. 8847 of 1960), and the distribution function bstr. 10691 of 1960) is used. F.Lachman

536.42

14890 REDUCING EVAPORATION WITH CETYL ALCOHOL FILMS: A NEW METHOD OF TREATING LARGE ATER STORAGES.

R.G.Vines.
stral. J. appl. Sci., Vol. 11, No. 1, 200-4 (March, 1960).

Monolayers of cetyl alcohol restrict the evaporation from natural ter surfaces. A technique has been developed for dusting the ter surface with a fine, dry cetyl alcohol powder. The powder is tained by shredding solid blocks of cast cetyl alcohol with a wire ush rotating at high speed. This is better than using a solution of mmercial cetyl alcohol in a volatile petroleum solvent, because the evitable contamination by retained solvent increases the tendency the film to collapse on compression. After floating a long time in ter, the excess cetyl alcohol becomes relatively ineffective and es not spread well. Commercial cetyl alcohols are mixtures of and sub-α phases. Their ability to spread deteriorates as the oportion of α phase, which is stabilized by stearyl alcohol, is creased. However, with a finely ground dry dust (0.1-0.01 mm par- le size) the total spreading perimeter is large, and a reasonable oportion of stearyl alcohol can therefore be introduced without rm. R.Schnurmann

536.42

14891 AN EXPERIMENT OF NUCLEATE BOILING UNDER REDUCED PRESSURE.

K.Nishikawa and K.Urakawa.
em. Fac. Engng Kyushu Univ., Vol. 19, No. 3, 139-47 (March, 60).

The apparatus and full details of the appearance (determined otographically) of the bubble formation and of the results of ex- riments carried out on the nucleate boiling of distilled water der pressures of 0.4 kg/cm^2 to atmospheric, are described. The ta obtained agree with the first author's correlation formula lem. Fac. Engng Kyushu Univ., Vol. 16, No. 1, 1 (1956)]. The efficient of heat transfer is proportional to the 0.4th power of e pressure. S.Weintroub

536.42

14892 NULL-POINT TORSION EFFUSION APPARATUS.

C.L.Rosen.
ev. sci. Instrum., Vol. 31, No. 8, 837-8 (Aug., 1960).

A null-point apparatus, capable of manual or automatic opera- on, for determining vapour pressures by the torsion effusion ethod is described. Vapour pressure measurements in the range $^{-6}$ to 10^{-2} mm Hg can be determined with an accuracy of ±1%. The nsitivity is constant over the entire pressure range and is in- uenced only by the choice of a suitable torsion wire.

536.42

14893 INFLUENCE OF FLOW VELOCITY ON THE DETERMINATION OF EQUILIBRIUM VAPOUR PRESSURES THE CARRIER GAS METHOD.

K.Hofmeister, R.v.Haeseler and O.Glemser.
Elektrochem., Vol. 64, No. 4, 513-17 (1960). In German.

In an experiment in which iodine was volatilized and nitrogen s the carrier gas, the volatilization of the iodine was the rate termining process. For vapour pressure determinations with the rrier gas method the condition of small partial pressure compared the total pressure is usually fulfilled. On the other hand, in those cases in which the partial pressure is of the same order as the total pressure, then the transported amount of material also depends on the ratio p/P. R.Schnurmann

536.42 : 536.7

FORCED VAPORIZATION OF SELECTED LIQUIDS.
See Abstr. 14908

536.46

14894 ON THE ASSUMPTIONS UNDERLYING DROPLET VAPORIZATION AND COMBUSTION THEORIES.

F.A.Williams.
J. chem. Phys., Vol. 33, No. 1, 133-44 (July, 1960).

A study is undertaken to determine the range of validity of the assumptions that (a) the liquid temperature is constant and equal to the boiling temperature for a burning droplet, (b) the instantaneous vaporization rate of a droplet at a given size is the same as that of a constant-diameter sphere of the same size, and (c) the duration of the initial unsteady period is much less than the total vaporization time of a droplet. It is shown that assumption (a) may lead to observable differences between the theoretical and experimental burning rates for low-energy fuels, that for practical purposes assumption (b) is probably always valid, and that approximation (c), which is most accurate for large values of the temperature at infinity, may lead to a 20% error in the computed value of the total vaporization time. The calculated duration of the initial unsteady period compares favourably with experiments on droplet ignition delay times.

536.46

14895 INTENSIFICATION OF COMPRESSION WAVES ON INTERACTION WITH THE FLAME FRONT.

S.M.Kogarko.
Zh. tekh. Fiz., Vol. 30, No. 1, 110-20 (Jan., 1960). In Russian.

During experiments with the burning of petrol—air and C_6H_6—air mixtures in a closed space, an intensification of compression waves was established experimentally to take place when the flame front propagated with an acceleration. Coefficients of intensification were determined for various mixtures. A tentative explanation is given of the mechanism of wave intensification upon interaction with the reaction zone of the flame front. In aircraft-petrol—air mixtures which, in the conditions of the experiment, do not yield a compression wave, the flame front was found to intensify an artificially generated compression wave, provided the amplitude of the latter exceeded a certain critical value. F.Lachman

536.5

14896 COMMENTS ON THE DETERMINATION OF THE [PHYSICAL] PROPERTIES OF SUBSTANCES HEATED TO HIGH TEMPERATURES BY MEANS OF SOLAR FURNACES.

M.Foex.
J. Rech. Cent. Nat. Rech. Sci., No. 50, 17-31 (March, 1960). In French.

The advantages of, and the difficulties encountered in, the use of solar furnaces for the heating of substances so as to determine their physical properties at high temperatures are briefly discussed. A description is then given of arrangements for the accurate measurement of the temperatures involved, and finally techniques for microscopy, X-ray spectrometry, thermal analysis, the measurement of specific heat, electrical conductivity, thermal conductivity, dilatation, and tests using the thermobalance, are briefly reviewed. 26 references. S.Weintroub

536.55

14897 MULTIPOINT DIGITAL TEMPERATURE RECORDER WITH PUNCHED TAPE OUTPUT.

T.S.Holden.
J. sci. Instrum., Vol. 37, No. 8, 269-72 (Aug., 1960).

A sixty-five point potentiometric recorder, which gives its output in binary form on punched tape directly suitable for use with a digital computer, is described. The instrument operates intermittently, and provides reference times and parity and logical sum checks with the other data on the output tape. Although designed for recording temperatures, the instrument may be readily adapted to other applications.

536.58 : 621.316.74

14898 TEMPERATURE REGULATOR FOR CLOSE TEMPERATURE CONTROL.

E.N.Herzberg.
J. sci. Instrum., Vol. 37, No. 8, 285-9 (Aug., 1960).

The design and performance of an electronic temperature regulator for an analytical oven of special construction is described. Stable temperature control with a resettability of better than 1°C is obtained over the range of 150-550°C. Residual peak-to-peak temperature fluctuations in the oven are less than 0.015°C.

536.58

14899 A GRADIENTLESS FURNACE.

P.D.Pathak and C.M.Bhavsar.

Curr. Sci., Vol. 29, No. 5, 177-8 (May, 1960).

The performance of a gradientless furnace, constructed to study the variation of an interference pattern with temperature, is described. The advantage of this furnace is that the gradientless condition can be obtained along a substantial length of the heater at any desired temperature without altering the nature of the winding. Details of the construction of the furnace are given. C.F.Barnaby

536.58

14900 OPTICAL HEATING SYSTEM FOR HIGH VACUUM ANNEALING STUDIES.

J.P.Ostriker and J.E.Davey.

Rev. sci. Instrum., Vol. 31, No. 5, 570-1 (May, 1960).

Describes the design of optical heating systems which are incorporated within the same vacuum system as the specimen. Measurements of temperature indicated that for the particular arrangements used, a quartz sample could be heated to a maximum of 800°C or 1175°C by using three or six 150 W sources; the limit is set by the heating of the walls of the sources. J.Dutton

536.65

14901 CONTRIBUTION TO THE DETERMINATION OF THE HEATS OF FUSION OF SOME METALLIC HALIDES. RELATION BETWEEN THE ENTROPY OF FUSION AND THE CRYSTALLINE STRUCTURE. M.Blanc.

Ann. Phys. (Paris), Ser. 3, Vol. 5, No. 5-6, 615-53 (May-June, 1960). In French.

Principles, conditions of application of the cryometric method used, and experimental techniques employed are discussed and described in detail. These involve the chemical and crystallographic nature of the respective solvents and solutes, their purity, superfusibility and the reproducibility of the data (determined in an atmosphere of argon to prevent oxidation). Results are reported for the alkaline and alkaline earth halides and for those of silver and lead. A relationship exists between the ratio of the radii (r^+/r^-) of the ionic constitutents and the entropy of fusion of the alkaline halides and of the lead halides, viz. for $r^+/r^- < 0.414$ the entropy increases in the same sense as the ratio, but is constant when $r^+/r^- > 0.414$. Deviations in the cases of LiCl and LiBr are explained, and anomalies for AgCl and AgBr are ascribed to abnormal structures. No conclusions could be drawn from the alkaline earth halide data. There are 45 references. H.H.Hodgson

THERMODYNAMICS

536.7

14902 A THERMODYNAMIC PROBLEM.

W.Jost.

Nachr. Akad. Wiss. Göttingen, math.-phys., Kl. IIa, 1959, No. 2, 25-8. In German.

The application of statistical thermodynamics to the defect structure equilibrium model,

$$\text{normal particles (1)} \overset{\Delta H^0}{\rightleftharpoons} \text{defect particles (2)},$$

leads to the conclusion that $\Delta C_p{}^0 = d\Delta H^0/dT = 0$. On the other hand, it follows from the model (by neglecting the volume effect) that $\Delta H^0 = U_2 - U_1 = U(T)$ and $\Delta C_p{}^0 = \beta$ if $U = U_0 + \beta T$. The author proceeds to resolve the contradiction. W.Good

536.7

14903 DISTINCTION BETWEEN QUASI-STATIC PROCESSES AND REVERSIBILITY. J.S.Thomsen.

Amer. J. Phys., Vol. 28, No. 6, 564-5 (Sept., 1960).

Extension of previous paper. See Abstr. 1063 of 1960.

536.7

14904 ON INVERSION OF THE LINEAR LAWS OF IRREVERSIBLE THERMODYNAMICS. E.Helfand.

J. chem. Phys., Vol. 33, No. 2, 319-22 (Aug., 1960).

A procedure is developed for inverting the linear laws of irreversible thermodynamics in spite of the singular nature of the admittance matrix when barycentric diffusion currents are employed. The procedure is symmetric in that it is unnecessary to identify one species as a reference solvent. Explicit relations are given for the new coefficients (resistance matrix, heats of transport, Soret thermal conductivity) in terms of the old. Constraints on the new coefficients are also obtained.

536.7 : 530.

THE FOUNDATIONS OF MECHANICS AND THERMODYNAMIC

See Abstr. 1423

536.

14905 THE PROBLEM OF THE EXISTENCE OF ENTROPY O DYNAMICAL SYSTEMS. V.Kh.Kozlovskii.

Fiz. tverdogo Tela, Vol. 2, No. 5, 922-8 (May, 1960). In Russian.

It is suggested that one cannot infer from the existing evidence the existence of entropy for arbitrary dynamical systems except when the systems are ergodic, with many degrees of freedom. The equations of state for the systems considered are also deduced. R.B.Stinchcomb

536.7 : 541.

ENTROPY PRODUCTION IN CHEMICAL REACTIONS.

See Abstr. 14098

536.

14906 ON THE RECIPROCAL RELATIONS OF ONSAGER.

B.D.Coleman and C.Truesdell.

J. chem. Phys., Vol. 33, No. 1, 28-31 (July, 1960).

Given any linear relation between forces and fluxes in irreversible thermodynamics, it is shown that redefinition of forces and fluxes by linear combination yields a relation with symmetric matrix. The rate of production of entropy is unchanged by the redefinition. Thus, unless "forces" and "fluxes" are defined by some property more specific than mere occurrence in the expression for production of entropy, there is no content in the statement that the matrix of phenomenological coefficients is or is not symmetric.

536.

14907 THERMODYNAMICS, STATIONARY STATES, AND STEADY-RATE PROCESSES. V. A COLLECTION OF COROLLARIES. R.J.Tykodi.

J. chem. Phys., Vol. 33, No. 1, 40-5 (July, 1960).

For Pts I - IV, see Abstr. 3691-4 of 1960. A listing is made of a number of direct consequences of the ideas and procedures developed in Pts I - IV; the topics considered are reaction equilibri in concentration and in thermal fields, thermocells, steady bitherm mass flow, and compound linkages. Some general remarks about monothermal fields are given.

536.7 : 536.42

14908 THERMODYNAMICS, STATIONARY STATES, AND STEADY-RATE PROCESSES. VI. FORCED VAPORIZATION OF SELECTED LIQUIDS.

T.A.Erikson and R.J.Tykodi.

J. chem. Phys., Vol. 33, No. 1, 46-9 (July, 1960).

The results of forced vaporization experiments are reported for water, carbon tetrachloride, benzene, methanol, and n-butyl alcohol. The data, which were obtained at a monothermal temperature of 25°C and with a tapered tube having available areas from 0.2 to 3.4 cm², indicate a linear relationship between the logarithm of the steady pressure maintained above the liquid and the steady mass flow per unit area. A number of complicating features in the experimental arrangement are discussed briefly.

536.7

14909 THERMODYNAMIC PROPERTIES OF HYDROGEN AND DEUTERIUM AT TEMPERATURES BETWEEN -175°C AND 150°C AND AT DENSITIES UP TO 840 AMAGAT.

A.Michels, W.de Graaff and G.J.Wolkers.

Physica, Vol. 25, No. 11, 1097-1124 (Nov., 1959).

From compressibility isotherms of hydrogen and deuterium published previously (see Abstr. 6838 of 1960) caloric and thermal functions have been calculated for the normal and equilibrium ortho-para concentrations. These properties are the energy, entropy, fre energy, enthalpy, free enthalpy, internal kinetic energy, specific heats, speed of sound, and Joule—Thomson coefficient. The data are presented at integral values of density and temperature. The results for the Joule—Thomson coefficient have been compared with literature data.

536.7

14910 FUGACITY AND FUNCTION F = H-TS OF NITROGEN UP TO 900 ATMOSPHERES, AT TEMPERATURES 300, 400, 500, 600, 700, 800 DEGREES CENTIGRADE. J.Saurel and A.Lecocq

Phys. Radium, Vol. 20, No. 2-3, 443-4 (Feb.-March, 1959). In ench.

The method of successive residues is used to evaluate the iso- rmal variations with pressure of the functions. P.Gray

536.7

14911 APPROXIMATE EQUATIONS FOR THE PROPERTIES OF SUPERHEATED STEAM. J.H.Horlock.

oc. Instn Mech. Engrs, Vol. 173, No. 33, 779-87 (1959).

It is found possible to express enthalpy to ±2 B.t.u./lb and ume to ±1.5% for pressures up to 2000 lb/sq in. and tempera- res up to 500°C, assuming that $C_p = g(S)$ and $R_a = f(S)$ only.

P.Gray

LOW-TEMPERATURE PHYSICS

536.48

14912 CRYOPHYSICS.

K.Mendelssohn.

ndon/New York: Interscience Publishers (1960) viii + 183 pp. terscience Tracts on Physics and Astronomy No. 7].

The book provides a general survey for interested workers in ier fields. As the author points out, it can also be used as an roductory textbook. There are eight chapters under the following adings: Cryogenics, Thermometry, Specific Heats, Magnetrom, ansport Phenomena, Superconductivity, The Helium Problem, iscellaneous. The final chapter considers a selection of current oblems. Each chapter concludes with an adequate series of refer- ces. There are two appendices, the first gives tables of vapour essure of H_2, He^4 and He^3 and the second, tables of Debye functions. umerous figures are provided throughout and there are four pages plates.

536.48 : 530.16

EQUATION OF STATE OF A BOSE—EINSTEIN SYSTEM OF RTICLES WITH ATTRACTIVE INTERACTIONS: COMPARISON TH He^4. See Abstr. 14531

536.48

14913 STUDY OF SUPERFLUIDITY IN LIQUID He BY ION MOTION. F.Reif and L.Meyer.

ys. Rev., Vol. 119, No. 4, 1164-73 (Aug. 15, 1960).

Ions produced in liquid helium by ionization with α-particles ere used as microscopic probe particles to study the properties of e superfluid. A time-of-flight method was used to measure rectly the drift velocity u of the ions in the liquid for various lues of the applied electric field $\mathcal{E}$ and at temperatures T down to 5°K. The field independent mobility $\mu^{(0)} = u/\mathcal{E}$ obtained in the mit of sufficiently small fields increases very rapidly below the point. Its temperature dependence over most of the temperature nge below 2°K is of the form $\mu^{(0)} = \alpha \exp(\Delta'/kT)$ and can be plained by the scattering of the ions from the collective excitations otons) present in the fluid. The nonlinear dependence of u on $\mathcal{E}$ at gher field strengths was also investigated and suggests the possi- lity of ions creating excitations in the quantum fluid as an important elastic scattering process at sufficiently large fields. Some lditional experiments are suggested.

536.48

14914 APPLICATION OF EHRENFEST EQUATIONS TO LIQUID—VAPOR AND LIQUID—SOLID MIXTURES OF e^4. O.V.Lounasmaa.

. chem. Phys., Vol. 33, No. 2, 443-5 (Aug., 1960).

Ehrenfest equations for the constant-volume phase transitions om the mixed liquid—vapour or liquid—solid system to pure liquid r vapour have been derived and applied in the case of He^4. Such rocesses serve as a model of second-order phase transitions. The easonably good agreement found indicates that these equations may e used to check experimental data at the boundaries of two-phase egions and to determine unknown quantities entering into them.

536.48

14915 EXPERIMENTAL BEHAVIOUR OF IONIC STRUCTURES IN LIQUID HELIUM II.

.Careri, U.Fasoli and F.S.Gaeta.

uovo Cimento, Vol. 15, No. 5, 774-83 (March 1, 1960).

Experiments were performed to select a proper model among some proposed structures for helium ions in liquid helium. The apparatus is essentially a diode, where the ions are produced by α-rays and the currents can be measured in the bulk liquid, in the liquid—vapour interphase and in the bulk solid. By the quite different behaviour of the positive and negative ions in the interphase experiments one is led to picture the positive ion as a cluster of polarized atoms around one charge, and the negative ion as a large cage where the electron is self-trapping.

536.48

14916 THE ROTATION OF LIQUID HELIUM II.

H.E.Hall.

Advances in Phys., Vol. 9, 89-146 (Jan., 1960).

This review article gives a coherent picture of the phenomena resulting from the presence of quantized vortex lines in superfluid helium. The starting point is Onsager's and Feynman's postulate of quantized circulation and its experimental demonstration by Vinen. Next the simplest case of an array of free vortex lines generated by uniform rotation of the superfluid is discussed. Their presence can be recognized by their effect on the attenuation of second sound, as their interaction with the normal fluid gives rise to mutual friction between the two fluids. The ends of the vortex lines attach themselves to rough surfaces, and under these conditions they are capable of transverse oscillations. Under conditions other than uniform rotation, namely mutual friction promoted by a heat current, or relative motion between superfluid and wall, irregular quantized vortex lines are produced which are described as superfluid turbulence. Under steady conditions an equilibrium between growth and decay processes is established. These can be studied seperately in transient experiments and semiquantitatively understood using dimensional arguments. Hitherto unsolved problems are the original nucleation of turbulence and the actual physical process of the creation and annihilation of vortex lines at the walls and within the body of the liquid. H.London

536.48

14917 HEAT CONDUCTION AND FOUNTAIN PRESSURE IN LIQUID He II. W.E.Keller and E.F.Hammel, Jr.

Ann. Phys. (New York), Vol. 10, No. 2, 202-31 (June, 1960).

Heat conductivity measurements employing temperature differences, ΔT, up to 1°K have been made for liquid He II through slits 2.13 μ and 3.36 μ wide and having stable, reproducible, and simple geometries. Heating curves have been obtained for twelve reference temperatures between 1.08°K and 2.15°K for both slits, each curve extending up to the λ-point. The validity of the London-Zilsel differential thermohydrodynamic equations is demonstrated for the limit of vanishing ΔT. In addition it is shown that when these linear equations are integrated with respect to temperature the range of validity can be extended to a much greater ΔT than heretofore expected. Data on the thermomechanical effect was obtained simultaneously, as well as with a separate slit 0.276 μ wide over the same temperature range. Fountain pressures, P_f, up to 600 mm Hg were observed. At low ΔT, P_f's are found consistent with those observed by previous investigators and in agreement with the integrated London relation. For larger ΔT's P_f's are found greater than expected from the theory. An anomalous lowering of the λ-point temperature with pressure, P_f, is observed. Also it is shown that the Allen—Reekie Rule (a relationship between heat current and P_f) as generally stated is not applicable. For both heat conductivity and fountain pressure, nonlinear effects are observed.

536.48

14918 STUDY OF THE EFFICIENCY OF AN ADIABATIC HELIUM LIQUEFIER OPERATING WITH AUXILIARY COOLING BY MEANS OF LIQUID NITROGEN. R.Blanpain.

Bull. Soc. Roy. Sci. Liege, Vol. 29, No. 5-6, 124-37 (May-June, 1960). In French.

The modifications at the various stages and the improvement in efficiency of an original (Abstr. 1858 of 1947) Collins helium liquefier produced by using liquid nitrogen as auxiliary coolant are theoretically considered. Experimentally, instead of the optimum liquefaction rate of 8 l./hr of helium, a rate of 4.5 to 4.9 l./hr for a consumption of 1.25 l. of nitrogen per l. of helium was obtained. The rate without the use of nitrogen was 1.4 to 1.5 l./hr.

S.Weintroub

536.48

14919 A CALCULATION OF THE THERMODYNAMIC PROPERTIES OF $^3He—^4He$ SOLUTIONS.

R.de Bruyn Outboter, J.J.M.Beenakker and K.W.Taconis.

Physica, Vol. 25, No. 11, 1162-76 (Nov., 1959).

The existing vapour—liquid equilibrium data on $He^3—He^4$

mixtures are analysed. From the vapour pressure measurements of Roberts and Sydoriak (1957) the change of the excess chemical potentials with concentration has been calculated in the temperature region between 0.6°K and 2°K. Below 1°K the mixture seems to behave as a regular solution.

536.48

14920 DENSITY OF THE NORMAL COMPONENT FOR SOLUTIONS OF He^3 AND He^4. S.K.Trikha.

Progr. theor. Phys., Vol. 19, No. 3, 346-8 (March, 1958).

Calculations of the density ratio ρ_n/ρ are compared with experiment on the basis of two different assumptions about the energy spectrum of pure He^4. The predictions of the two models differ only slightly and agree well with experiment. The author concludes that the important feature is the quantum nature of the liquid He^4 rather than the details of its energy-spectrum. H.N.V.Temperley

536.48

14921 THEORY OF SOLID HE^3.

N.Bernardes and H.Primakoff.

Phys. Rev., Vol. 119, No. 3, 968-80 (Aug. 1, 1960).

A theoretical analysis is given of the properties of solid He^3 on the basis of: (1) a gas-phase Lennard-Jones 12-6 potential modified at small interatomic distances; (2) a Heitler—London type variational-trial wave-function for all the atoms in the solid constructed from a properly antisymmetrized product of individual atom orbitals localized on the various lattice points; (3) a Dirac vector model to describe the symmetry energy with an exchange integral deduced from (1) and (2); (4) a spin-wave approximation at "low" temperatures and a Kramers—Opechowski approximation at "high" temperatures for calculation of the free energy of the nuclear spins; and (5) a Debye phonon model for the description of the vibrationally excited states of the solid. On this basis, calculated values at low pressures and temperatures ($p \approx 30$ atm; $T <\sim 1$ °K) are presented for: (a) the cohesive energy per atom; (b) the root mean square deviation of an atom from its lattice site: $\cong 0.36 \times$ nearest neighbour distance; (c) the nuclear magnetic susceptibility which corresponds to an antiferromagnetic behaviour with a "paramagnetic" Curie temperature $T_C \cong 0.1$ °K; (d) the variation (decrease) of T_C with increasing pressure corresponding to a possible nuclear antiferromagnetic to nuclear ferromagnetic transition for $p \approx 150$ atm; (e) the specific heat which exhibits an anomaly at $T \approx 0.1$ °K associated with the alignment of the nuclear spins; (f) the thermal expansion coefficient which becomes negative below about 0.6 °K; (g) the melting curve which is characterized by a minimum at $T \cong 0.37$ °K. Comparison is made with available experimental data.

536.48

14922 A GENERALIZATION OF GOR'KOV'S METHOD FOR THE CASE OF ELECTRON—PHONON INTERACTION.

M.V.Bulkov.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 561-4 (May 21, 1960). In Russian.

The method of Green functions is used for constructing a theory of superconductivity, as in Gor'kov's work (Abstr. 7982 of 1958) but it is not assumed that the electron—phonon interaction is small. The case of T = 0 is considered. R.Berman

536.48

14923 ON THE THEORY OF SUPERCONDUCTIVITY.

D.N.Zubarev.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 5, 1055-8 (June 11, 1960). In Russian.

The method of retarded and advanced Green functions is applied to the thermodynamics of the superconducting state. As an example it is shown that the derived energy difference between the normal and superconducting states at absolute zero agrees with that obtained by Bogolyubov (Abstr. 7034 of 1958). R.Berman

536.48 : 530.16

MATHEMATICAL ASPECTS OF BARDEEN, COOPER, SCHRIEFFER THEORY. See Abstr. 14536

536.48

14924 THE SUPERCONDUCTING STATE IN THE BETHE—GOLDSTONE APPROXIMATION.

A.Katz, A.de-Shalit and I.Talmi.

Nuovo Cimento, Vol. 16, No. 3, 485-9 (May 1, 1960).

Using a soluble model for the many-body problem it is shown that the Cooper-type solution to the Bethe—Goldstone equation yields the exact value for the ground state energy of the system. The B.C.S. method yields the ground state energy to order $1/\Omega$.

536

14925 EXACT TREATMENT OF BARDEEN'S THEORY OF SUPERCONDUCTIVITY IN THE STRONG COUPLING LIMIT. Y.Wada, F.Takano and N.Fukuda.

Progr. theor. Phys., Vol. 19, No. 5, 597-8 (May, 1958).

It is shown that the problem of particles interacting only with particles of opposite spin and momentum, which is considered in Bardeen, Cooper, and Schrieffer theory of superconductivity (Abs 1708 of 1958), is equivalent to a problem of fixed particles with spin $\frac{1}{2}$ interacting both with one another and with an external field There is an obvious strong-coupling solution of the second proble and this gives an exact solution of the strong-coupling limit of the first problem. Several terms in a strong-coupling expansion are given. The solution used by Bardeen, Cooper, and Schrieffer can obtained by treating the spins classically. D.J.Thoule

536.

14926 GAUGE INVARIANCE AND THE MEISSNER EFFECT.

N.Fukuda, Y.Wada and S.Otake.

Progr. theor. Phys., Vol. 21, No. 2, 343-53 (Feb., 1959).

A gauge-invariant theory of a many-electron system in an external magnetic field, interacting through arbitrary velocity dependent two-body forces, is presented. The energy spectrum fo a "free" electron is also assumed to be arbitrary to take into acc the self-energy due to its interaction with the phonon field. If the two-body forces are neglected, it is shown that no Meissner effect is obtained so long as the energy spectrum is continuous together with its first-order derivative. Bardeen's energy gap model is reconsidered from this standpoint and is shown to be drastically changed.

536.

14927 ON THE GAUGE-INVARIANT MEISSNER EFFECT.

S.Nakajima.

Progr. theor. Phys., Vol. 21, No. 2, 357-8 (Feb., 1959).

Tomonaga's theory of collective motion is used to discuss the Meissner effect. It is shown that this gauge-invariant discussion leads to an answer only slightly different from that obtained by Bardeen, Cooper, and Schrieffer (Abstr. 1708 of 1958). D.J.Thoules

536.

14928 IMPURITY EFFECT IN SUPERCONDUCTORS.

K.Nakamura.

Progr. theor. Phys., Vol. 21, No. 3, 435-40 (March, 1959).

The influence of non-magnetic impurities on superconductivity is investigated on the basis of Bardeen, Cooper and Schrieffer's theory. It is shown that the impurity-scattering of electrons leads to the reduction of the energy difference between the superconducti state and the normal state, and the effective reduction of the electron—electron interaction due to phonon exchange and screened Coulomb force takes place as a result. This effect can account for the reduction of the superconducting transition temperature which was observed for tin by Lynton, Serin and Zucker. The calculated value of the change in the transition temperature is in agreement with the experimental one.

536.48 : 539.

14929 DISPERSION OF PLASMA FREQUENCIES AND SCREENED EXCHANGE ENERGY IN THE SUPERCONDUCTING STATE. L.Tewordt.

Z. Naturforsch., Vol. 15a, No. 5-6, 490-502 (May-June, 1960). In German.

The theory of superconductivity by Bardeen, Cooper and Schrieffer is continued consistently on the basis of the collective representation of Bardeen and Pines. For the B.C.S. quasi-particle pairs one obtains the equation of motion with the complete Hamiltonian of the electrons (this includes the B.C.S. basic contribution plus the interactions between electron pairs with a total momentum different from zero and zero total spin, which is neglected by B.C.S according to the generalized random phase approximation. Using these, the corrections to the matrix elements of the density fluctuations in relation to the matrix elements with B.C.S. excitations are determined. The corrected matrix elements are introduced into the general expressions for the longitudinal dielectric constant and the screened exchange energy as obtained from the ordinary, well founded, random phase approximation according to the formulation analogous to that of Nozieres and Pines. The results are as follows The plasma frequencies and the components of the screened exchang rgy for small wave numbers are not influenced by the normal—rconductive transition. Thus the results of B.C.S. on the consation energy of the superconducting state at absolute zero remain ect, even if one takes account of the long range Coulomb-inter-on energy. H.London

536.48

4930 ON CRITICAL MAGNETIC FIELDS OF SUPERCONDUCTORS. S.Nakajima.

gr. theor. Phys., Vol. 21, No. 2, 358-9 (Feb., 1959).

It is shown that the magnetic field produced by a supercurrent roys superconductivity before the current reaches the maximum e allowed by the theory of superconductivity, if magnetic effects neglected. D.J.Thouless

536.48

14931 COMPARISON OF THE MACROSCOPIC THEORY OF SUPERCONDUCTIVITY WITH EXPERIMENTAL DATA.

.Ginzburg.

eksper. teor. Fiz., Vol. 36, No. 6, 1930-3 (June, 1959). In sian. English translation in: Soviet Physics—JETP (New York), . 36(9), No. 6, 1372-3 (Dec., 1959).

A reconsideration of the Ginzburg—Landau theory (Abstr. 2894 .956) in the light of Gorkov's result (Abstr. 10836 of 1960) that effective charge in that theory should be 2e. R.G.Chambers

536.48

14932 SUPERCONDUCTIVITY OF FERROMAGNETIC METALS. T.Kasuya.

gr. theor. Phys., Vol. 20, No. 6, 980-2 (Dec., 1958).

An s—d interaction that can produce ferromagnetism inhibits erconductivity. Numerical estimates are made to show that thanum should be a superconductor, but that other rare earth tals, iron, and nickel have too strong an s—d interaction to be erconductors. D.J.Thouless

536.48 : 539.2 : 538.2

SOME FURTHER RESULTS ON FERROMAGNETISM IN LATION TO SUPERCONDUCTIVITY. See Abstr. 13753

536.48

14933 FAR-INFRARED ENERGY GAP MEASUREMENTS IN BULK SUPERCONDUCTING In, Sn, Hg, Ta, V, Pb, AND Nb.

.Richards and M.Tinkham.

ys. Rev., Vol. 119, No. 2, 575-90 (July 15, 1960).

Measurements were made of the onset of absorption due to itation of electrons across the energy gap. Using the onset of main absorption edge as a measure of the energy gap, the values $E_g(0)$, the energy gap at absolute zero, were found to be 4.1 ± 0.2 for indium, 3.6 ± 0.2 kT_c for tin, 4.6 ± 0.2 kT_c for mercury, .0 kT_c for tantalum, 3.4 ± 0.2 kT_c for vanadium, 4.1 ± 0.2 kT_c lead, and 2.8 ± 0.3 kT_c for niobium. The deviations of these ues of the energy gap from the Bardeen—Cooper—Schrieffer ue of 3.5 kT_c are a fairly smooth function of the Debye tempera-e alone, but a less smooth one of the ratio of the Debye tempera-e to the critical temperature. Structure was found on the absorpn curves of lead and mercury. Its interpretation is discussed in ms of possible states in the gap, anisotropy of the gap, and of a ssible dielectric anomaly. The position of the main absorption ge seemed to scale with temperature according to the temperature pendence of the energy gap predicted by the Bardeen—Cooper—rieffer theory, and the structure appeared to have a roughly nilar temperature dependence. The absorption curves for pure perconductors are compared with predictions based on the theory the skin effect in the normal and superconducting states. Two oy superconductors were studied. They appeared to have less ll-defined gaps than the pure superconductors.

536.48

14934 INVESTIGATION OF THE X-RAY SPECTRA OF THE SUPERCONDUCTING COMPOUND CuS.

.Borovskii and I.A.Ovsyannikova.

. eksper. teor. Fiz., Vol. 37, No. 5(11), 1458-60 (Nov., 1959). Russian.

Briefly describes spectral measurements of the K emission es and absorption edges of two non-superconducting materials mely copper and sulphur and then compares these with the rresponding lines in superconducting CuS. A curved quartz ystal spectrometer was used. An interpretation of the observed ectral shifts is given in terms of electron energy levels.

T.Mulvey

536.48 : 539.2

THERMAL CONDUCTIVITY AND ABSORPTION OF SOUND IN SUPERCONDUCTORS. See Abstr. 13500

536.48 : 539.2

ANISOTROPY OF THE ABSORPTION COEFFICIENTS OF ULTRASONICS IN SUPERCONDUCTORS. See Abstr. 13501

ELECTRICITY

ELECTRICAL MEASUREMENTS

537 : 536

14935 THERMIONIC THERMAL—ELECTRICAL ENERGY CONVERTERS. L.N.Dobretsov.

Zh. tekh. Fiz., Vol. 30, No. 4, 365-94 (April, 1960). In Russian.

Review of the whole field, dividing diodes into three types: (1) The theory of a vacuum diode with space charge is straightforward and agrees with experiment. It is unlikely that the technical difficulties can be overcome to obtain useful amounts of power. (2) For the space charge compensated by positive ions (Cs^+) the theory and experiment are also in good agreement. Discusses experiments in which large powers at relatively high efficiencies were produced, the limit being set by the rate of evaporation of the tungsten cathode at the necessarily high temperatures (~3000° K). (3) At high Cs pressures the interpretation of observations is complicated by the formation of an interelectrode plasma. Some experimental arrangements working in this regime (including conversion of nuclear energy) are discussed. R.Berman

537.7

14936 PHASE PRODUCTION AND MEASUREMENT FROM 0 TO 2π. J.B.Hart, F.X.Haas and G.M.Hofmeyer.

Amer. J. Phys., Vol. 28, No. 6, 537-8 (Sept., 1960).

The Helmholtz coil phase generator produces a continuous phase change from 0 to 2π in a signal of any frequency over a range limited by the coils used. A method and two unique rules are presented for determining the phase difference between two signals by means of an oscilloscope.

537.7 : 621.317 772

14937 RATIOMETER PHASE ANGLE INDICATOR. K.L.Morphew.

J. sci. Instrum., Vol. 37, No. 8, 300-2 (Aug., 1960).

The principle of the moving coil ratiometer is described together with the circuit used with it for phase angle measurement. The mode of operation, performance, adjustment, and calibration are given.

537.7 : 621.317.335

14938 A SWITCH FREE OF INSULATING MATERIAL. U.Kümmel and D.Palme.

Exper. Tech. der Phys., Vol. 8, No. 1, 37-9 (1960). In German.

The object of the device described was to connect the crystal under test either to a source of voltage or to an electrometer, without having any other insulating support in parallel with the crystal. The device uses magnets to support the conductor and to achieve the change-over operation. K.W.Plessner

537.7 : 621.317.71

14939 A METHOD OF MEASURING AND RECORDING EXTREMELY SMALL CURRENTS. L.L.Dekabrun.

Zh. tekh. Fiz., Vol. 27, No. 7, 1578-83 (July, 1957). In Russian.

Currents in the range 10^{-14}-10^{-16} A are measured with an accuracy of about 10%. Elementary charges are counted, integrated and stored in an automatic recurrent cycle of up to 1 sec duration. The measured current is separated from noise background by chopping and filtering. The working cycle is timed by synchronous motor and relays. Full circuit details are given of the electronic part of the instrument, which includes an electron multiplier tube and 21 common valve types. F.Quelon

537.7 : 621.317.714

14940 ERROR OF RECTIFIER-TYPE MILLIAMMETERS IN LOW-RESISTANCE CIRCUITS.

J.Wilbur-Ham and W.E.K.Gibbs.

J. sci. Instrum., Vol. 37, No. 9, 313-15 (Sept., 1960).

Although a bridge-rectifier meter indicates r.m.s. current when the current is sinusoidal, a sinusoidal voltage produces a non-sinusoidal current, and hence an error in the indication, because the resistance of a copper-oxide rectifier is non-linear, varying as the -0.7 power of the current. Series resistance tends to swamp the non-linearity, and the error, calculated by arithmetical integration, is shown on a nomogram relating error, series resistance and meter indication. Experiment confirms the results.

537.7 : 621.317.723

14941 **PORTABLE ELECTROMETER VOLTMETER.**
W.E.K.Gibbs.
J. sci. Instrum., Vol. 37, No. 8, 296 (Aug., 1960).

A high impedance d.c. voltmeter is described for measuring voltages up to 2V at impedances of up to 10^{10} ohms. The accuracy attained is about 2% of full-scale deflection and the short-term zero drift is also of this order.

537.7 : 621.317.723

14942 **HIGH-SPEED ELECTROMETERS FOR ROCKET AND SATELLITE EXPERIMENTS.** J.Praglin and W.A.Nichols.
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 771-9 (April, 1960).

Highly stable micromicroammeters capable of measuring currents as low as 5×10^{-14} A with a frequency response of at least 30 c/s can be realized using d.-c. electrometers. The circuitry can be packaged in approximately 9 in^3 and requires less than 100 mW. An analysis of the speed of response and signal-to-noise ratio is given and expressions are derived to show the theoretical possibilities of the method and to serve as design guides for realization of the maximum possible performance. Several practical circuits are shown and a summary is presented of the number of circuits which have been used in rocket and satellite exploration.

537.7 : 621.317.34

14943 **PHOTOELECTRIC METHOD FOR THE ANALYSIS OF FLUCTUATION RECORDS AND ITS APPLICATION TO ELECTRICAL NOISE.** J.Scott.
Brit. J. appl. Phys., Vol. 11, No. 8, 377-81 (Aug., 1960).

Describes a method for obtaining the after-effect function for a stationary-fluctuation process from a record in the form of a graph or oscillogram. The method has been applied to the statistical analysis of some records of electric noise from various sources. Future possible developments of the method are indicated.

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2

14944 **AN APPARATUS FOR THE MEASUREMENT OF DIELECTRIC LOSS IN FINELY-DIVIDED SOLIDS.**
J.E.A.Stuart, G.Manuel, R.D.Smith, A.C.D.Newman and L.E.Sutton.
Trans Faraday Soc., Vol. 55, Pt 12, 2180-5 (Dec., 1959).

An impedance bridge is described for measuring the dielectric loss of powders at frequencies of from 33 to 27 000 c/s over the range from room temperature to 120° C. The apparatus, designed particularly for studying the small electrical changes accompanying the adsorption of vapours (see next abstract) is most suitable for specimens with capacity in the region of 200 pF, and with loss angle of the order of 10^{-2} radians or less. The capacity of such specimens can be determined to within 0.1 pF, and the loss angle to within 10^{-4} to 10^{-5} radians.

537.2 : 541.18

14945 **A DIELECTRIC STUDY OF THE ADSORPTION OF WATER BY MAGNESIUM HYDROXIDE.**
S.M.Nelson, A.C.D.Newman, T.E.Tomlinson and L.E.Sutton.
Trans Faraday Soc., Vol. 55, Pt 12, 2186-202 (Dec., 1959).

Measurements of dielectric loss angle and dielectric constant have been made for specimens of powdered magnesium hydroxide on which water vapour is adsorbed, over a frequency range of 33 c/s to 20 Mc/s, and over a temperature range of 18° to 100° C. Adsorption isotherms were studied, and surface areas determined by the Brunauer–Emmett–Teller method. A remarkable lack of reproducibility of results was found from specimen to specimen, or with a particular specimen over dehydration-rehydration cycles. From the variation of frequency of maximum loss with temperature, values for enthalpy and the entropy of activation for dipole rotation were calculated. The initial values of the former were about 12 kcal/mole; but they fell gradually during dehydration-rehydration cycles to about 5 kcal/ Furthermore, the spread of dipole relaxation times decreased at given temperature. These observations indicate that the adsorbi surface ages markedly during the experiments, and that the wate is more water-like on the aged surface than on the new one. Possible mechanisms of the processes are discussed.

537.2 : 5

14946 **THE PROBLEM OF DETERMINING THE PERMITTIVITY AND PERMEABILITY TENSORS OF A MEDI**
G.S.Krinchik and M.V.Chetkin.
Zh. eksper. teor. Fiz., Vol. 36, No. 6, 1924-5 (June, 1959).
In Russian. English translation in: Soviet Physics—JETP (New
Vol. 36(9), No. 6, 1368-9 (Dec., 1959).

It is pointed out that, in order to determine whether the gyrotropy of a medium is connected with the anisotropy of permittivit or with that of permeability one must perform experiments, e.g. flection experiments, in which the magnetization vector is perpe dicular to the plane of incidence of the light. Existing experimen data show that metallic ferromagnetics at optical frequencies possess gyroelectric properties, while ferrites at centimetre wavelengths possess gyromagnetic properties. L.Pinch

53

14947 **THE ELECTROSTATIC ENERGY OF SOME SPACE CHARGES.** O.Emersleben.
Hochfrequenztech. u. ElektAkust., Vol. 68, No. 4, 111-18 (Nov., 1
In German.

The e.s.energy of spherical cubical and tetrahedral space-charge clouds are calculated by finite-difference methods using cubic and tetrahedral grids. A.H.W.B

53

14948 **THE CONDITION FOR PRESERVATION OF THE GEOMETRY OF AN ELECTROSTATIC FIELD DURIN INTRODUCTION OF A VOLUME CHARGE.** L.É.Tsÿrlin.
Zh. tekh. Fiz., Vol. 27, No. 7, 1587-8 (July, 1957). In Russian.

The shape of equipotentials of an electrostatic field will rem unchanged on introduction of a volume charge into this field if the boundary of that charge satisfies the equation

$$\frac{h_2 h_3}{h_1} = g(\alpha_1)\, p(\alpha_2 \alpha_3)$$

where g and p are arbitrary functions, α_1, α_2, α_3 are general cur linear coordinates and h_1, h_2, h_3 are their corresponding metric coefficients, while the field-generating electrode boundary equati is $\varphi_0 = \varphi_0(\alpha_1)$. J.K.Skwirzyn

53

14949 **NUMERICAL ÇALCULATION OF THE POTENTIAL DISTRIBUTION DUE TO A GRID PLACED BETWEEN TWO PARALLEL PLATES.** C.Peligry.
C.R. Acad. Sci. (Paris), Vol. 250, No. 25, 4108-10 (June 20, 1960).
In French.

A relaxation method is used to calculate equipotentials for th following configuration: grid-wire diameter of 2 units; distance between plates — 11 units; distance between grid and one plate — 4 units; distance between grid wires — 6 units. Three basic cas (with potentials on one of the plates or on the grid) are used to derive more general potential distributions (illustrated).
J.K.Skwirzyn

CURRENT ELECTRICITY
ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3 : 621.383.

14950 **SOLAR BATTERIES.**
A.F.Daniel.
Proc. Inst. Radio Engrs, Vol. 48, No. 4, 636-41 (April, 1960).

A short summary is provided of the applications of solar cell in satellites. A discussion of the apparent reliability and efficienc olar cells in operating situations and the environmental factors cting solar cells is presented. A brief discussion is also given e various methods of mounting solar cells with succinct ments on the advantages and disadvantages of different methods. rence is also made to quality control methods and the quality us cost problem. A detailed discussion is given of energy-ersion devices which employ static methods for direct conver- of solar energy to electrical energy, i.e., those types which ze the thermoelectric, Edison (thermionic emission), photo-aic and photoemission effects. The relative merits of these ems based on present and anticipated conversion efficiencies reviewed.

537.3 : 621.383.8

14951 INFRARED DETECTOR SILICON SOLAR CELL POWER SUPPLY. L.W.Schmidt and J.I.Davis.

c. Inst. Radio Engrs, Vol. 47, No. 9, 1519-20 (Sept., 1959).

Silicon cells may be used to provide a voltage bias for a photo-ductive detector, or the power supply for the signal amplifier.
C.Hilsum

537.3 : 621.317.71

14952 SENSITIVE AND SIMPLE INTEGRATOR.
J.P.Funk.

sci. Instrum., Vol. 37, No. 8, 276-8 (Aug., 1960).

A sensitive and simple battery-operated current integrator is cribed. It uses as sensing element a standard millivoltmeter or croammeter, the pointer position of which is sampled at regular ervals by electromechanical means, the required movement of a ler then being converted into rotation of a counter. The integrator epts signals of varying polarity and also indicates the extreme nal level during any chosen period. It is particularly suited for integration of quantities such as daily totals of net or global liation.

537.3

14953 CONDITIONS FOR A FAMILY OF SURFACES OBTAINED BY VARYING A PARAMETER TO REPRESENT THE UIPOTENTIALS OF THE FIELD OF A POSSIBLE SYSTEM OF NDUCTORS. P.Harmegnies.

ll. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 2, 70-4 (1960).
French.

The necessary and sufficient conditions are established, and e illustrated by an example.
P.M.Davidson

537.3

14954 ON THE EXCESS PHOTON NOISE IN SINGLE-BEAM MEASUREMENTS WITH PHOTO-EMISSIVE AND IOTO-CONDUCTIVE CELLS. C.T.J.Alkemade.

ysica, Vol. 25, No. 11, 1145-58 (Nov., 1959).

The so-called excess photon noise is theoretically considered th regard to noise power measurements with a single, illumined oto-emissive or photo-conductive cell. Starting from a modifica-n of Mandel's stochastic association of the emission of photo-ectrons with wave intensity, the frequency dependence of the excess ise power with photo-emissive cells is derived. Use is made of rmulas given by Rice for square-law detectors. A new hypothesis introduced in order to calculate the excess photon noise effect ith photo-conductive cells, in which the statistics of both the citation and of the recombination have to be considered. It is own that in the case of an ideal photo-conductor in thermodynamic uilibrium with the radiation field the result obtained is consistent ith the expected Fermi-statistics for the electron gas. It is shown at under certain experimental conditions the excess photon-noise fect is detectable in noise-power measurements with a single otocell. This applies especially to the case of an i.r. sensitive oto-conductive or photo-emissive cell with a quantum-yield near unity.

537.32

14955 STABILITY OF RHENIUM/TUNGSTEN THERMO-COUPLES IN HYDROGEN ATMOSPHERES.

C.Lachman and F.W.Kuether.
S.A. J., Vol. 7, No. 3, 67-9 (March, 1960).

The thermal e.m.f. developed at 1000°C was measured, and gain after thermal cycles consisting of heating to successively igher temperatures for varying periods of time and cooling back to 000°C. The results for thermal cycles up to 2350°C are listed. he total thermal shift was less than 4%. The experimental pparatus used is briefly described.
S.Weintroub

537.32 : 621.362

14956 PERFORMANCE OF A THERMOELECTRIC CONVERTER UNDER CONSTANT HEAT FLUX OPERATION.

P.S.Castro and W.W.Happ.
J. appl. Phys., Vol. 31, No. 8, 1314-17 (August, 1960).

The performance characteristics of a conventional thermoelectric generator operating under constant heat flux conditions were computed. Expressions for power output, optimum efficiency, and optimum ratio of internal-to-load resistance show that optimization requires operating conditions appreciably different from those for the operation of thermoelectric generators having constant hot- and cold-junction temperatures. Performance curves are presented for the optimum ratio of internal-to-load resistance when either the internal resistance or the load resistance is under the control of the designer.

IONIZATION

537.56

14957 SEALED-ROOM EXPERIMENTS ON THE EQUILIBRIUM OF IONIZATION IN AIR.

O.C.Jones, R.S.Maddever and J.H.Sanders.
J. atmos. terrest. Phys., Vol. 17, No. 1-2, 134-44 (1959).

In an attempt to establish the correct form of the equation describing the equilibrium of ionization in air periodic measurements were made of Z and n, the concentrations of condensation nuclei and of small ions respectively inside a sealed room. It was found that n increased linearly with time in the initial stages, whilst Z decreased in agreement with an equation proposed by Nolan. These results did not fit the type of equilibrium equation usually assumed. In further experiments direct measurement showed that q, the rate of production of ion pairs, varied considerably with time, controlling the course of the equilibrium. A possible explanation of the observed change in q is suggested.

537.56

14958 RESIDUAL IONIZATION OF A GAS EXPANDING IN VACUUM. Yu.P.Raizer.

Zh. eksper. teor. Fiz., Vol. 37, No. 2(8), 580-2 (Aug., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 2, 411-12 (Feb., 1960).

Derives expressions from which may be calculated the residual ionization resulting from the rapid heating of a substance to a temperature of several tens of thousands of degrees and its subsequent expansion into a vacuum; a numerical example is given for solid iron heated to 116 000°K.
J.Dutton

537.56

14959 STATISTICAL PROBLEMS IN ENERGY LOSS AND IONIZATION PROCESSES. J.R.Herring and E.Merzbacher.

J. Elisha Mitchell Scientific Society, Vol. 73, No. 2, 267-79 (Nov., 1957).

Gives an alternative method of deriving the distribution (originally obtained by Landau, Abstr. 23 of 1947) of energy of an originally monoenergetic beam of particles which have passed through a layer of material, thin compared with the range of the particle. Expressions are derived from which curves are computed of (1) the probability as a function of the initial energy E ($0 < E < 12$ Rydbergs), that an electron produces 0, 1, 2 or 3 ion pairs in atomic hydrogen, and of (2) the mean, and the variance of the number of ion pairs produced by an electron as a function of E ($0 < E < 5$ Rydbergs). Hence further computations are made of the probability q_k that a high-energy (1 MeV) α-particle will give rise to k ion pairs as a result of an ionizing collision; the values of q_k obtained are compared with those used by Moyal (Abstr. 3850 of 1955).
J.Dutton

537.56

14960 EXCHANGE EFFECTS ON THE PHOTO-DETACHMENT CROSS-SECTION OF H⁻. T.L.John.

Astrophys. J., Vol. 131, No. 3, 743-4 (May, 1960).

Gives a table in which values for the photo-detachment cross-section of H^- (over a range of wavelengths from 505 to 16482 A) calculated from the dipole velocity formula, using a 20-parameter H^- wave-function (Abstr. 6475 of 1957) and exchange functions for free waves, are compared with those calculated (Abstr. 5852 of 1959) using central-field functions for free waves.
J.Dutton

537.56

14961 IONIZATION AND ATTACHMENT COEFFICIENTS. MEASUREMENT IN HUMID AIR IN UNIFORM FIELDS, AND MECHANISM OF BREAKDOWN.

A.N.Prasad and J.D.Craggs.
Rep. Brit. Elect. Res. Assoc., Rep. L/T390, 11 pp. (1959).

Measurement of pre-breakdown currents and breakdown potentials in humid air in the E/p range of 30-40 V/cm/mm Hg at total pressures of 150 and 300 mm Hg with partial pressures of water vapour in the range 2.5-15 mm Hg indicate a pronounced increase in attachment compared with conditions in dry air. From the semi-logarithmic plots of current against electrode separation, Townsend's ionization coefficient α and an attachment coefficient η have been obtained for humid air employing the modified Townsend equations for the growth of current. From the measured breakdown potentials values of Townsend's secondary coefficient γ have been calculated using the modified Townsend breakdown criterion. Further, the percentage increase in breakdown potential in humid air has been plotted as a function of the partial pressure of water vapour. From similar measurements in pure water vapour at pressures of 10 and 20 mm Hg in the E/p range of 30-50, values of α/p and η /p have been obtained for water vapour. A mean cross-section for attachment has been computed for various values of mean electron energies assuming a Maxwellian distribution and employing the earlier measurements of drift and agitational velocities.

537.56

14962 SOLUBLE THREE-DIMENSIONAL MODEL FOR TOWNSEND'S α.

G.W.Stuart and E.Gerjuoy.
Phys. Rev., Vol. 119, No. 3, 892-9 (Aug. 1, 1960).

A model gas is considered in which all electron—molecule cross-sections are isotropic and depend inversely on the velocity v. Collisional energy loss is neglected. The Boltzmann equation for the model is solved for the collision density, where the collision density is the number of collisions that an individual electron makes between v and v + dv over its entire history. The Townsend α is obtained from the collision density, and it is found that α/p is inversely proportional to E/p. It is argued that this model furnishes an upper bound to the true α/p for all E/p; therefore it is concluded that this model demonstrates that at sufficiently high E/p the observed α/p for any real gas must decrease with increasing E/p. The results also shed light on the way electron energy balance or lack of energy balance affects α/p and the drift velocity v_D; it is shown that energy balance is not possible at arbitrarily large E/p. Numerical applications of these results to H_2 are discussed.

537.56

14963 IONIZATION POTENTIALS OF B_5H_9, B_5H_8I, $B_{10}H_{14}$, AND $B_{10}H_{13}C_2H_5$ FROM ELECTRON IMPACT STUDIES.

J.L.Margrave.
J. chem. Phys., Vol. 32, No. 6, 1889 (June, 1960).

As the mass spectra of these materials are very complicated, appearance potentials for the heaviest ion peak of each molecule were determined. Thus, ionization potentials of 11.1 ± 0.5 eV (B_5H_8I), 10.8 ± 0.5 eV (B_5H_9), 11.0 ± 0.5 eV ($B_{10}H_{14}$), and 9.0 ± 0.5 eV ($B_{10}H_{13}C_2H_5$) were obtained. R.Schnurmann

537.56 : 539.18

14964 DETERMINATION OF THE FIRST IONIZATION POTENTIALS OF THE NEODYMIUM AND PRASEODYMIUM ATOMS BY A SURFACE IONIZATION METHOD.

N.I.Ionov and M.A.Mittsev.
Zh. eksper. teor. Fiz., Vol. 38, No. 4, 1350-1 (April, 1960).
In Russian.

The method and its theory were described previously (Abstr. 9709 of 1959; 10874 of 1960). A brief account of the determination is given; it was based on the theory that if the ionization potential is greater than the work function log $(J_1/J_2) = f(1/T)$ is a straight line, where J_1 and J_2 are ionization currents of the simultaneously ionized atoms of respective elements in a composite surface. Knowing the ionization potential of one, that of the other can be determined from the above function. The ionization potential of Pr was found to be 5.48 ± 0.01 eV, using a number of specially prepared composite coatings of In and Pr on tungsten. Similarly, using coatings of In and Nd on tungsten, the ionization potential of Nd was found to be 5.51 ± 0.02 eV. J.M.Zarzycki

537.56

14965 MULTIPLE IONIZATION IN ARGON AND KRYPTON BY ELECTRON IMPACT.

R.E.Fox.
J. chem. Phys., Vol. 33, No. 1, 200-5 (July, 1960).

The formation of multiply charged ions by electron impact in argon and kryptons was studied with a mass spectrometer. The behaviour of the ionization cross-section as a function of electro energy was investigated for electron energies up to 600 eV. The ionization potentials in eV were determined to be as follows: Kr^{2+} 38.45 ± 0.1, Kr^{3+} 75.6 ± 0.5, Kr^{4+} 146.6 ± 2, Kr^{5+} 217.5 ± Kr^{6+} 350 ± 10, Ar^{2+} 43.4 ± 0.3, Ar^{3+} 84.8 ± 0.5, Ar^{4+} 150.0 ± 5. The shapes of the ionization curves near threshold were studied and discussed in terms of the threshold law for ionization. The maximum cross-section for each multiply charged ion was determined relative to that of the singly charged ion and compared to data obtained by previous investigators.

537

14966 THE IONIZATION OF FAST NEUTRAL DEUTERIUM ATOMS BY HYDROGEN AND BY DEUTERIUM.

L.P.Chalklin and J.H.Fremlin.
Proc. Phys. Soc., Vol. 75, Pt 6, 850-4 (June, 1960).

Neutral deuterium atoms of energy 8 MeV from the Birmingh cyclotron were passed through hydrogen and deuterium gas at lo pressure. Ionized particles were separated by the cyclotron mag netic field from the original beam and the numbers in each beam were found by counting tracks on a nuclear emulsion. Cross-sections for ionizing collisions were found to be 1.6 ± 0.25 × 10^{-1} and 2.3 ± 0.25 × 10^{-18} cm^2 in hydrogen and in deuterium respectively.

537

14967 IONIZATION OF Cu, Ag, AND Au BY ELECTRON IMPACT.

N.C.Blais and J.B.Mann.
J. chem. Phys., Vol. 33, No. 1, 100-5 (July, 1960).

The relative ionization probabilities of copper, silver, and go by electron impact have been studied near threshold. Nearly monoenergetic electrons, obtained by means of the retarding potential difference method, were employed. Narrow peaks were found superimposed on the ion yield that arises from transition to the ion ground state. It was possible to correlate these peaks wit groups of energy levels, many of which are known to autoionize. ionization probability curve for formation of doubly ionized gold also obtained and found to be a sum of linear functions of the elec excess energy. The onset of each linear section indicated the presence of an excited state of Au III. Three energy levels were located at 2.2_6, 3.9_2, and 7.8_1 eV above the ground state.

537

14968 CROSS SECTION FOR FORMATION OF DOUBLY-IONIZED HELIUM BY ELECTRON IMPACT.

H.E.Stanton and J.E.Monahan.
Phys. Rev., Vol. 119, No. 2, 711-15 (July 15, 1960).

The cross-section for the formation of He^{2+} by electron impa was measured relative to that of He^+ for electron energies betwee 100 and 2400 eV. A relative minimum in the measured ratio of th yields of He^+ to He^{2+} at an energy of about 600 eV is believed to b real. For incident energies above 1400 eV the results are consistent with a constant value of 145 for this ratio.

537.

14969 SECONDARY REACTIONS IN A GAS DISCHARGE.

I.B.Ortenburger, M.Hertzberg and R.A.Ogg, Jr.
J. chem. Phys., Vol. 33, No. 2, 579-83 (Aug., 1960).

The pressure variations of H^+, H_2^+, H_3^+, He^+, and HeH^+ ions emanating from an electrodeless discharge in pure hydrogen and mixtures of hydrogen and helium were measured. Mass analysis was accomplished with a "strong-focusing" mass spectrometer. T analysis of the results in hydrogen are discussed, as well as the alternative mechanisms for hydrogen dissociation. From the resu in hydrogen—helium mixtures, a value of 0.37 ± 0.15 is obtained f the ratio k_2'/k_1', where k_2' is the rate constant for reaction $He^+ + H_2 \rightarrow HeH^+ + H$ and k_1' is the rate constant for the reaction $H_2^+ + H_2 \rightarrow H_3^+ + H$. In addition, a value of 0.016 ± 0.013 is obtained for the ratio k_3'/k_2', where k_3' is the rate constant for the reaction $H_2^+ + He \rightarrow HeH^+ + H$.

537.

14970 MASS SPECTROMETRIC AND INFRARED EMISSION INVESTIGATION OF THE VAPOR SPECIES IN THE B—S SYSTEM AT ELEVATED TEMPERATURES.

A.Sommer, P.N.Walsh and D.White.
J. chem. Phys., Vol. 33, No. 1, 296-7 (July, 1960).

ZnS and B were made to react at 700-900°C in graphite refrac tories. From the variation of ion intensity with electron energy, the boron-containing species resulting from primary ionization we tified as $B_2S_3^+$, $B_2S_2^+$, BS_2^+, and, as a minor constituent, $B_2S_2O^+$. observed BS_2^+ may possibly not be a primary species, as its zation potential was anomalously high. The species corresponding S_2 was not observed in the B—O system. Of the three observed ared emission bands the two of highest frequency are assigned $_2S_3$ and B_2S_2. The lowest observed frequency probably arises n a B—S stretching vibration. An isotope shift of 47 cm^{-1} was erved when, on the one hand, boron of natural isotopic abundance used, and, on the other, a sample containing 96% B^{10}. The B=S B—S bond energies were determined as 125 and 100 kcal/mole, pectively. R.Schnurmann

537.56

14971 MASS-SPECTROMETRIC STUDY OF THE OSMIUM—OXYGEN SYSTEM.

.Grimley, R.P.Burns and M.G.Inghram.
hem. Phys., Vol. 33, No. 1, 308-9 (July, 1960).

Between 1100 and 1750°K, OsO_3^+ and OsO_4^+ (with approximate earance potentials of 12.3 ± 1 and 12.6 ± 1 eV) were found to be main ionic species. Above 1700°K evidence for the existence of table OsO_2 molecule was obtained. The intensity of the OsO_2 cies is 1/1000 of the OsO_3 intensity. R.Schnurmann

537.56

14972 THERMODYNAMIC PROPERTIES OF UNIPOSITIVE GASEOUS ELEMENTAL IONS.

.Green, D.E.Poland and J.L.Margrave.
chem. Phys., Vol. 33, No. 1, 35-9 (July, 1960).

Thermodynamic properties are calculated from available energy-el data for a range of temperatures from 100° to 50 000°K.

537.56 : 551.5

14973 A DISCUSSION OF THE MOTION IN NITROGEN OF FREE ELECTRONS WITH SMALL ENERGIES WITH FERENCE TO THE IONOSPHERE. L.G.H.Huxley.

atmos. terrest. Phys., Vol. 16, No. 1-2, 46-58 (Oct., 1959).

Measurements of diffusion and drift of slow electrons in pure trogen carried out by Crompton and Hall are discussed. The dis-ssion is restricted to the range of energies of the electrons be-een that of thermal equilibrium and four times that value. From behaviour of the coefficient of diffusion D it is concluded that in astic collisions between electrons and nitrogen molecules the llisional cross-section A is proportional to the speed c of the ectron; namely, $A = 3.29 \times 10^{-23}\, c\, \mathrm{cm}^2$. From this result an ac-rate expression is derivable for the velocity of drift W in terms the parameter Z/p and the mean energy of agitation of the elec-ons. The measured rate w at which electrons with energy Q lose ergy in collisions with molecules is accurately described by a rmula that ascribes these losses of energy chiefly to the excita-n of changes in the rotational states of the molecules. A formula close agreement with the measurements is derived for the depen-nce of the mean energy of agitation of the electrons upon Z/p. The gnificance of the measurements for ionospheric studies is con-dered with particular reference to the interpretation of measure-ents of radiowave interaction. It is shown that the values of the olecular concentration in the height range 82 to 90 km above the ound, found by means of radiowave interaction, are consistent with e A.R.D.C. model atmosphere (Minzner and Ripley, 1956).

537.56

14974 ELECTRICAL AND THERMAL CURRENTS IN A SLIGHTLY IONIZED GAS. M.S.Sodha.

ys. Rev., Vol. 119, No. 3, 882-6 (Aug. 1, 1960).

The Boltzmann equation is solved for electrons in a slightly nized gas under the influence of an electric field (a.c. + d.c.), a agnetic field and temperature gradient. Expressions for the elec-ical and thermal currents are obtained in terms of integrals having llision frequency and f_0, the isotropic part of the distribution func-n, in the integrand. A differential equation for f_0 is set up and alytical expressions obtained under simplifying assumptions. The plication of the analysis to transport properties and electromag-tic wave propagation is also indicated.

537.56

14975 DIFFUSION OF CHARGED PARTICLES ACROSS A MAGNETIC FIELD DUE TO NEUTRAL PARTICLES.

P.Wright.
hys. of Fluids, Vol. 3, No. 4, 607-10 (July-Aug., 1960).

A calculation of the diffusion of charged particles across a agnetic field arising from the presence of neutral particles is mpared with the diffusion arising from charged particles. The ratio of the flux of charged particles, arising from the presence of neutral particles, and the flux arising from charged particles is found to be of the order 10^2 to 10^5. The actual value of the ratio depends on the types of particles, the temperature, the number densities, and the density gradients.

537.56 : 541.18

14976 TOWARDS A THEORY OF THE CHARGING OF NON-MICROSCOPIC AEROSOL PARTICLES AS A RESULT OF THE CAPTURE OF GASEOUS IONS. G.L.Natanson.

Zh. tekh. Fiz., Vol. 30, No. 5, 573-88 (May, 1960). In Russian.

The problem is treated in detail. Tables for the ionic flow, equal in stationary conditions to the rate of ion capture, are calculated for the cases of the capture of (a) an oppositely charged, and (b) a similarly charged ion by a charged particle, and (c) the capture of an ion by a neutral particle. The influence of forces of interaction, at distances from the surfaces of the particles less than the mean free path, are calculated. The results are applied to calculate the stationary charge of non-microscopic (i.e. with mass sufficiently greater than that of the ions to allow the motion of the former to be neglected) aerosol particles in a bi-polar ion atmosphere and for an analysis of the process of the electrostatic precipitation of such particles. G.A.Chisnall

537.56

14977 ON RESONANT CHARGE TRANSFER FOR POSITIVE IONS. I.Popescu-Iovitzu and N.J.Ionescu-Pallas.

Proc. Phys. Soc., Vol. 75, Pt 5, 807-9 (May 1, 1960).

Gives the results of semi-empirical one-electron calculations of the effective charge to be used, when the wave-function is taken to be a simple 1s orbital, in order to obtain agreement with experiments on the variation of charge-transfer cross-section with impact energy of an ion beam on its parent gas. Gases studied were He, Ne, A, Kr, Xe, Hg and K. J.Hawgood

537.56

14978 DIRECT PROOF OF THE APPLICABILITY OF THE MASSEY ADIABATIC CRITERION TO PROCESSES OF DOUBLE CHARGE EXCHANGE.

Ya.M.Fogel', V.F.Kozlov, A.A.Kalmŷkov and V.I.Muratov.
Zh. eksper. teor. Fiz., Vol. 36, No. 4, 1312-14 (April, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 4, 929-31 (Oct., 1959).

See Abstr. 2455 of 1959. Further experiments on the dependence on ion velocity of the effective cross-sections for double charge exchange for ions in inert gases are described. Ions examined were B^+, O^+ and Li^+, and for the latter the forms of the curves obtained with unexcited (thermionic) ions and with excited ions from a high-frequency ionic source were compared, and shown to be derivable from the same value of the Massey criterion. All the results confirm the applicability of the criterion. J.Hawgood

ELECTRIC DISCHARGES

537.52

14979 TRANSFER OF IGNITION ENERGY FROM THE DISCHARGE ON BREAKING [CONTACTS] TO A GAS MIXTURE. N.A Popov.

Zh. tekh. Fiz., Vol. 30, No. 1, 105-9 (Jan., 1960). In Russian.

It is established experimentally that in a discharge which occurs on breaking contacts at low currents, the absolute temperature of the isothermal plasma formed is independent of the power of the discharge and is approximately equal to 6000°. It is shown that it is not the high temperature of the discharge but the spatter of molten metal which transfers the ignition energy to the gas mixture. Z.Krasucki

537.52

14980 THE INVESTIGATION OF HIGH FREQUENCY PLASMAS WITH A D.C. PROBE.

H.Fetz and H.Oechsner.
Z. angew. Phys., Vol. 12, No. 6, 250-3 (June, 1960). In German.

Describes a double probe arrangement for use in h.f. (51 Mc/s) discharges. Data are presented for argon at 4×10^{-3} mm Hg pressure when the electron temperature was 55000°K (7×10^{10} electrons/cm^3). J.D.Craggs

537.52

14981 THE MECHANISM OF ELECTRICAL EROSION OF METALS IN LIQUID DIELECTRIC MEDIA.

B.N. Zolotÿkh.

Zh. tekh. Fiz., Vol. 29, No. 12, 1484-6 (Dec., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 12, 1370-3 (June, 1960).

The erosion of a 1 mm diameter copper cathode caused by a single pulse discharge of duration 180 μsec in kerosene was investigated using a high-speed photographic technique; photographs at times from 80 to 484 μsec after the begining of the pulse are given. The anode was a copper plate, the gap distance 30 microns, the maximum voltage 200 V, the maximum current 1000 A and the energy of the pulse 2.5 J. The observations are discussed in terms of the hydrodynamical problem of the expansion of a spherical piston, and it is concluded that hydrodynamic and gas-dynamic processes play important roles in the electric erosion of metals.

J.Dutton

537.52

14982 REACTION BETWEEN COPPER AND SOLID OXYGEN CONDENSED AT VERY LOW TEMPERATURES FROM A GAS DISCHARGE.

J.Kruger and W.J.Ambs.

Nature (London), Vol. 186, 794-5 (June 4, 1960).

Solid discharge products were observed on copper surfaces cooled to temperatures between 4.2 and 40°K and subjected to a stream of discharged pure oxygen. It was shown that the reaction was not caused by either molecular oxygen or ozone and did not occur if the microwave discharge was removed. W.G.Townsend

537.52

14983 RECOMBINATION COLUMN BETWEEN POSITIVE IONS AND ELECTRONS IN NITROGEN.

P.Marin and B.Vo-Xuan.

J. Phys. Radium, Vol. 20, No. 2-3, 444-6 (Feb.-March, 1959). In French.

Calculations of the effect of recombination on the signals produced by a heavy charged particle are applied to the case of an electric field for pressures of several atmospheres. The results are presented graphically, and differ from those for no field at low pressures. P.Gray

537.52

14984 SEPARATION OF MAGNETIC DRIVING AND OHMIC HEATING.

J.R.Banister.

Phys. of Fluids, Vol. 3, No. 4, 648-55 (July-Aug., 1960).

In this experiment, brief unidirectional current discharges were passed through nitrogen in the presence of a transverse uniform magnetic field. The gas between the electrodes was heated and given a directed velocity. Since flow is limited to the direction of this directed velocity, the usual shock-tube theory modified for this velocity may be used to describe shock development. This theoretical method, which provides separation of the roles of magnetic driving and Ohmic heating, was found to be precisely applicable until the material traverses more than half the electrode dimension during the discharge. The technique seems potentially useful for studying plasma conductivity and equation of state.

537.52

14985 DIPPING OF POTENTIAL ON THE AXIS OF THE OSCILLATING ELECTRON TYPE OF DISCHARGE.

M.D.Gabovich, O.A.Bartnovskii and Z.P.Fedorus.

Zh. tekh. Fiz., Vol. 33, No. 3, 345-53 (March, 1960). In Russian.

Details are given of an experimental investigation of the causes of deep potential troughs in the plasma found by others (Abstr. 2455 of 1954). It was found that the depth of the troughs increases with the intensity of the magnetic field and with the square of the anode diameter. This, it is shown, agrees with theoretical considerations, which in turn suggest that the presence of an axial magnetic field reduces the diffusion of electrons towards the anode.

J.M.Zarzycki

537.52

14986 LOCALIZATION OF A HIGH-FREQUENCY INDUCTION DISCHARGE.

M.D.Raizer and S.E.Grebenshchikov.

Zh. eksper. teor. Fiz., Vol. 37, No. 2(8), 564-5 (Aug., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 2, 398-400 (Feb., 1960).

Photographic, spectroscopic and electrical measurements on pulsed h.f. induction discharges in an axially symmetric magnetic field in air, H_2 and He for gas pressures in the range 1-1000 mm Hg, show that clearly defined plasma loops are formed; some properties of these loops are given. J.Dutton

537.52 : 621.315.618.

14987 THE EFFECTS OF NUCLEAR RADIATION ON THE ELECTRICAL STRENGTH OF AIR.

G.I.Duncan, J.C.Fraser and B.Valachovic.

Trans Amer. Inst. Elect. Engrs III, Vol. 79, 19-26 (1960) = Comm and Electronics, No. 47 (March, 1960).

Tests with rod gaps spaced 0.0625 and 0.125 in. apart, show t between 100 and 160°C the breakdown voltage in air at 760, 76 and 7.6 mm Hg pressure is some 10 to 20% lower, when the gap is subjected to intense irradiation ($\sim 10^{12}$ γ-photons cm^{-2} sec^{-1}) than with unirradiated gaps. A similar reduction was found with a 0.25 in. gap at 7.6 and 76 mm Hg pressure, but at 760 mm there w an inexplicable increase in b.d.v. J.H.Masc

537.

14988 THRESHOLD POTENTIAL FOR THE LOW FREQUEN ELECTRIC DISCHARGE IN AIR USING A MAZE COUNTER.

H.D.Sharma.

Acta phys. Polon., Vol. 17, No. 2-3, 183-6 (1958).

The threshold potential V_m for a low-frequency electric discharge in air was determined over a range of pressure p from 1 t 300 mm Hg. The V_m—p curves are not linear, being concave towards the pressure axis. For a given wire diameter (2r), V_m is seen to increase as the diameter of the outer glass cylinder increases. A comparison is also made using the rX—rp curves wh X is the field strength at the wire surface. While these curves a pear to coincide at low rp values, at higher values there is difference, the values of rX for the largest tube being the least.

537.

14989 INFLUENCE OF THE INNER ELECTRODE ON THE THRESHOLD POTENTIAL USING SIEMEN'S TYPE OZONIZERS UNDER LOW FREQUENCY SILENT ELECTRIC DISCHARGE.

H.D.Sharma.

Nuovo Cimento, Vol. 16, No. 1, 128-34 (April 1, 1960).

Reports the observations of the threshold potential V_m for the low frequency silent electric discharge using Siemen's ozonizers for air over a range of pressure from 1 to 400 mm Hg. The V_m—p curves are not linear, being concave towards the pressure axis. These results further indicate that unlike the case of the out cylinders where small changes in the dimensions do not influence t curves appreciably, in this case small changes in the dimensions o the inner cylinders do influence the curves appreciably.

537.

14990 SOME RESULTS OF INVESTIGATION OF HIGH-CURRENT CORONA IN HYDROGEN.

V.A.Burmakin, V.G.Gubanova and P.N.Chistyakov.

Zh. tekh. Fiz., Vol. 30, No. 2, 199-205 (Feb., 1960). In Russian.

Positive corona in hydrogen was investigated using a coaxial electrode system with currents of up to 1 mA/cm. The instability of corona voltage in 50 hours was less than 0.1 per cent with 200 μA/cm. It is shown that the V—A characteristics of corona are greatly influenced by thermal effects and this effect increases with corona current. The region of corona discharge in hydrogen ends by a transition into a glow discharge. In the transition region between corona and glow discharges a hysteresis is observed in th V—A characteristic. Z.Krasuck

537.5

14991 THE EFFECT OF PULSE PERIODICITY IN CORONA, AS MEASURED BY THE HIGH FREQUENCY SPECTRU

W.Heintz.

Z. angew. Phys., Vol. 12, No. 7, 320-2 (July, 1960). In German.

Describes experiments made on the noise analysis of the electrical current flowing in negative point-plane corona in air.

J.D.Crag

537.

14992 FUNDAMENTAL PROCESSES IN THE IONIZATION ZONE OF CORONA FROM LEADS AT ATMOSPHERIC PRESSURE.

G.N.Aleksandrov.

Izv. Akad. Nauk SSSR, Ser. Fiz., Vol. 23, No. 8, 989-94 (1959). In Russian.

The fundamental processes of positive corona, negative coron and bipolar corona (between points of opposite polarity or under a. are discussed in some detail. It is concluded that the positive discharge in bipolar (critical) corona, unlike unipolar positive corona, should be continuous from its onset. Z.Krasuck

537.52

14993 INVESTIGATION OF STRIATIONS IN ARGON.

A.V.Nedospasov, G.I.Pankova and V.F.Konakh.

tekh. Fiz., Vol. 30, No. 1, 125-8 (Jan., 1960). In Russian.

Simultaneous measurements of the characteristics of striations the ionic current to the walls of the tube enabled the determina- n of degree of ionization at the head of a stria. This enabled ification of basic theoretical results obtained earlier by one the authors.

Z.Krasucki

537.52 : 77

14994 A 450 J SPARK DISCHARGE FOR SHADOWGRAPH PHOTOGRAPHY.

L.Whitlow.

sci. Instrum., Vol. 37, No. 8, 259-60 (Aug., 1960).

To allow shadowgraph photographs to be taken of jet engines in itude test cells, a 450 J spark discharge is used. This emits fficient light to illuminate a large working area and to allow mour plate and heat-resistant glass to be used for the cell windows. e design and construction of a suitable spark gap is given. The ze of the light source is about 1 mm diameter and the flash ration is 1.9 μs. Details are also given of tests carried out on rious insulating and electrode materials.

537.52

14995 SPECTROSCOPIC INVESTIGATION OF THE TRANSPORT OF MATERIAL IN THE PRE-BREAKDOWN PHASE OF HE HIGH VACUUM BREAKDOWN.

S.Schwabe.

angew. Phys., Vol. 12, No. 6, 244-50 (June, 1960). In German.

The pre-breakdown region of high-vacuum (gas pressure less an 2×10^{-6} mm Hg) discharges between plane and spherical ectrodes, for voltages in the range from 20 to 75 kV, was investi- ted by measuring the current as a function of voltage and the mount of electrode material transported as a function of the mean rrent; microscopic examination of the surfaces of the electrodes fore and after the passage of current, was also carried out. The sults support the "clump" theory (Abstr. 5803 of 1952).

J.Dutton

537.52

14996 TEMPERATURE OF A SPARK DISCHARGE CHANNEL IN AIR.

A.A.Mak.

tika i Spektrosk., Vol. 8, No. 2, 278-9 (Feb., 1960). In Russian.

Reports that the spark-channel temperature in air ($\sim 30\,000^{0}$ K) as practically independent of the rate of current rise between 10^{6} d 10^{12} A/sec.

A.Tybulewicz

537.52

14997 MICROWAVE BREAKDOWN OF AIR IN NONUNIFORM ELECTRIC FIELDS.

P.M.Platzman and E.H.Solt.

ys. Rev., Vol. 119, No. 4, 1143-9 (Aug. 15, 1960).

A new approach to the problem of diffusion-controlled breakdown nonuniform fields is presented. Two specific cases are considered detail. The geometrical configurations involved are, respectively, rectangular microwave cavity with a small hemispherical boss on e of its walls and a similar cavity without a boss. The theoretical edictions of the method are compared with a series of microwave eakdown measurements in air. The theoretical results are found be in good agreement with the observed experimental data.

537.52

14998 AN INVESTIGATION OF SPARK DISCHARGE IN HELIUM.

M.P.Vanyukov, A.A.Mak and V.R.Muratov.

ptika i Spektrosk., Vol. 8, No. 4, 439-45 (April, 1960). In Russian.

Sparks were passed through a discharge tube filled with helium commercial purity at 2.5-12 atm. The time dependences of the rc and spark line profiles were studied in the wavelength region 500-5500 A. A strong continuous background was emitted in the itial stages of the discharges, with two intense spark (He II) lines 4686 and 3203 A superimposed on this background. Arc lines of elium (He I at 3188, 3889, 4470, 4471 and 5016 A) appeared about .3-0.5 μsec from the beginning of the discharge. The electron con- entrations ($N \cong 10^{-17}$ cm^{-3}) in the spark discharge channel, deduced rom the half-widths and shifts of the He I lines at 3889 and 5016 A, iffered between themselves by 200-300%.

A.Tybulewicz

537.52 : 539.19

14999 SPARKING POTENTIAL AND MOLECULAR STRUCTURE OF UNSATURATED HYDROCARBON GASES.

.W.Crowe and J.C.Devins.

. chem. Phys., Vol. 33, No. 2, 413-18 (Aug., 1960).

Previous experiments have shown that it is possible to relate sparking potentials of saturated hydrocarbons gases to certain molecular properties. From measurements of electric breakdown in a series of these gases, it has been found that the effective molecular cross-section for electron scattering is proportional only to the number of carbon—hydrogen bonds in the molecule and is independent of their disposition. The lack of a contribution by the carbon—carbon bonds has been attributed to a shielding effect. Here the results of a similar investigation of breakdown in unsaturated hydrocarbon gases is described and discussed. It was found that, for a series of olefin gases, the cross-section, associated with the carbon—carbon double bond is greater than three times that of the carbon—hydrogen bond, while that of the carbon—carbon single bond is essentially zero as it was in the alkane series. An attempt is made to interpret this observation in terms of (a) a decrease in the shielding effect, and (b) the larger spatial configuration of the π-electron orbitals associated with the ethylenic linkage. Variations in the position of the double bond within the molecule have little or no effect upon its contribution to the total cross-section. Breakdown measurements in butadiene-1,3 and benzene indicate that conjugation results in an increase in the effective cross-section of each double bond, as might be excepted. Evidence of a small but measurable amount of double-bond character was also found in cyclopropane from sparking potential measurements. This is in agreement with the predictions of other investigators.

537.52

15000 EXPLANATION OF THE ENHANCED ARC VELOCITY ON MAGNETIC ELECTRODES.

P.E.Secker.

Brit. J. appl. Phys., Vol. 11, No. 8, 385-8 (Aug., 1960).

When an arc moves between parallel horizontal metal electrodes, under the influence of the transverse magnetic field set up by current flow in the electrodes, the velocity/current charcteristic is found to depend on the cathode material. The characteristics may be separated into two groups, one comprising the magnetic and the other the non-magnetic materials. Calculations indicate that the enhanced velocity of the former group is due to a high-frequency skin effect near the rapidly moving cathode spot, such that the current paths are forced to the outer regions of the electrode, so increasing the transverse magnetic flux density in the critical region just outside the cathode.

537.52

15001 GLOW-DISCHARGE CHARACTERISTICS OF HELIUM—ARGON MIXTURES.

G.F.Weston.

Brit. J. appl. Phys., Vol. 11, No. 7, 305-6 (July, 1960).

Presents data on the breakdown voltage as a function of pressure × gap length, using plane parallel diodes. Normal cathode falls (Mo electrode) are also given, and there is a brief discussion of the minimum breakdown potential—normal cathode fall relation.

J.D.Craggs

537.52

15002 SPARK CHANNELS IN LIQUIDS — INTERIM REPORT.

M.Papadoyannis and J.B.Higham.

Rep. Brit. Elect. Res. Assoc., Rep. E/T68, 5 pp. (1956).

The electrical characteristics and the rates of expansion of spark channels in liquids were measured. The experiments show that the expansion during the first 10 μsec is controlled by an expanding cylindrical shock wave surrounding the channel and that ion diffusion later plays a minor part.

537.52

15003 ELECTRIC BREAKDOWN OF LIQUID DIELECTRICS—INTERIM REPORT.

K.C.Kao.

Rep. Brit. Elect. Res. Assoc., Rep. E/T69, 5 pp. (1957).

Experimental techniques have been developed and apparatus constructed to facilitate investigation of the effect of temperature on electric strength. A theory is postulated to explain the observed results.

PLASMA

537.56

15004 ON THE "LARMORON" PLASMA THEORY.
S.A.Kaplan.

Zh. eksper. teor. Fiz., Vol. 36, No. 6, 1927-8 (June, 1960). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 6, 1370-1 (Dec., 1959).

Proposes the term "larmoron" to define a quasi-particle representing a real charged particle orbiting in a magnetic field. Its position is that of the guiding centre, it has an energy equal to the total energy of the real particle, and a lifetime approximately equal to the free-flight time of the real particle. Some simple plasma properties are deduced on the basis of this model. R.S.Pease

537.56

15005 STATISTICAL MECHANICS OF AN INHOMOGENEOUS AND ANISOTROPIC LORENTZIAN PLASMA: A STUDY OF THE ELECTRON DISTRIBUTION.
R.Jancel and T.Kahan.

J. Phys. Radium, Vol. 20, No. 10, 804-11 (Oct., 1959). In French.

Based on the results obtained in an earlier paper (see Abstr. 3594 of 1959), the system of equations is given which allows calculation of the terms of zero order, as well as the terms of order one, of the expansion of the distribution function. For an external oscillating electric field, a stationary solution is obtained by a Fourier analysis superimposed upon the expansion in spherical harmonics. The earlier results are generalized to this case. Physical problems which can be dealt with by these methods are indicated.

537.56

15006 BOLTZMANN—VLASOV EQUATION FOR A QUANTUM PLASMA.
O. von Roos.

Phys. Rev., Vol. 119, No. 4, 1174-9 (Aug. 15, 1960).

An equation is derived which is a quantum mechanical analogue of the classical collision-less Boltzmann equation. A new quantum mechanical distribution function is employed which is particularly useful in this case. Quantum corrections for longitudinal plasma oscillations are evaluated for a low-density plasma, and it is found that the leading contribution ($\sim\hbar^2$) is due to exchange (Pauli principle).

537.56

15007 SOME PROPERTIES OF A THIN PLASMA OF VARIABLE DENSITY.
L.Simons.

Comment. phys.-math. (Helsinki), Vol. 24, No. 3, 16 pp. (1959).

A plasma in an axial magnetic field is considered, the density function of which is continually falling in the direction of increasing radius, with the density gradient being fixed and finite. It is shown that, at every instant, and in very cross-section perpendicular to the cylinder axis, electron currents are in opposite directions so that the total electron current equals zero. The currents thus change direction every half period. The sheet current that arises at constant plasma density is a special case depending on the fact that the density rapidly approaches zero at the plasma boundaries. Because of the ion motions, a magnetic field is induced which has different strength for ions at different distances from the axis. This phase difference increases with time and may give rise to very effective impacts. For variable plasma density, the expression for this phase difference contains the same expression for the density gradient as does the expression for the electron current density. Thus there is a connection between the phase difference for ions at different distances and the electron current density. A specific consequence of this is that a strong sheet current is followed by strong turbulence at the boundary.

537.56

15008 NOTES ON THE MAGNETIC MIRROR EFFECT.
M.Sato.

Progr. theor. Phys., Vol. 20, No. 5, 737-42 (Nov., 1958).

An elementary theory is presented to estimate the rate of charged particle loss from the ends of a magnetic mirror device.

537.56

15009 A MAGNETIC TRAP WITH FIELD INCREASING TOWARDS THE PERIPHERY.
S.Yu.Luk'yanov and I.M.Podgornyi.

Zh. eksper. teor. Fiz., Vol. 37, No. 1(7), 27-32 (July, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 1, 18-21 (Jan., 1960).

Describes experiments on containment of injected electrons (~0.5 A at <~1 kV) in axially symmetrical cusp fields (~1000 gauss in a metal container (21 cm bore, 100 cm long). The electrons we injected axially and escaped predominantly from the cusp apices. In a multiple cusp system, high background gas pressure equalize the escape rates at all the apices. In a single cusp system, the geometrical width of the "leak" was measured as a function of magnetic field strength, electron energy and background gas press At high fields, this width is predominantly controlled by the electron cathode area as imaged at the cusp. Evidence of diffusion broadening, and of the effect of a large electron Larmor radius wa found. R.S.Pea

537.56 : 539.

MAGNETIC CONFINEMENT OF THERMONUCLEAR REACTIONS. See Abstr. 13383

537.

15010 THE INFLUENCE OF INDUCTION ON ION AND ELECTRON CURRENTS IN A THIN PLASMA.
L.Simo

Comment. phys.-math. (Helsinki), Vol. 24, No. 6, 9 pp. (1960).

The influence of induction on the ion motion and electron currents in a thin cylindrical plasma of deuterium has been calculate The plasma is embedded in a confinement field and is heated by io cyclotron heating. The calculations have been carried out for energies up to the fusion threshold, both for constant plasma densi and for a density dropping to zero at the plasma boundary. Simple formulae for the relative phase shift between ions at different distances from the cylinder axis have thus been obtained. Formulae for the corresponding phase shifts of the electron currents are als obtained.

537.

15011 ENERGY LOSS OF A MODULATED ION BEAM IN A PLASMA WITH A MAGNETIC FIELD.
R.Kippenhahn and H.L.de Vries.

Z. Naturforsch., Vol. 15a, No. 5-6, 506-12 (May - June, 1960). In German.

A beam of ions penetrating a plasma perpendicular to a homogeneous field is investigated. The particle density of the beam ma be modulated by varying the intensity of the ion source with the fre quency ω. For simplicity, the ions are assumed to move with equa velocity w. The modulation of the beam produces oscillations of th plasma and the ions of the beam will loose energy; therefore it should be possible to trap the injected particles in the plasma. Furthermore, the kinetic energy of the trapped particles will be tr formed into thermal energy of the plasma. The ion source is assu to deliver a linear beam (of sufficiently small diameter). Upon bei shot into a plasma with a magnetic field, the ions will travel along curve. In order to treat the problem exactly one would have to sol simultaneously the equations of motion for the plasma coupled with those for the individual ions of the beam. In the present paper, the problem is simplified in that the equation of motion of the ions in t beam is not solved. Instead it is imagined that they are forced to travel in a straight beam. The problem becomes especially simple if one assumes the ion source to be a slit instead of a point source Then the ions do not all travel along the same straight line, but in parallel straight lines in the plasma. The direction of motion is always perpendicular to the magnetic field. Then one may distingu two cases of the relation of the field direction to the direction of th plane: (1) the field lines are parallel to the plane of the beam; (2) the field lines are normal to the plane. If the modulating freque of the beam is small compared with the gyrofrequency of the electr and with the plasma frequency, if the conductivity is infinite, and if the gas pressure in the plasma may be neglected, one obtains for t mean relative energy loss of an ion per cm of path, in the parallel ca

$$2\pi r_1 \frac{N_2^2}{N_1} \frac{1}{P} \frac{Q + P - 1}{(P - 1)^{1/2}} \; (P > 1).$$

(N_1 number of particles per cm^2 of beam surface of the unmodulate part of the beam, N_2 the number of ions per cm^2 of the modulated part, r_1 the classical ion radius, P the square of the ratio of ion velocity to Alfven velocity, Q the square of the ratio of the modulating frequency to the ion gyro-frequency). In the case of $P = 1$ the energy loss of the beam is infinite. For $P < 1$ the energy loss will vanish identically. In the normal case the energy loss each particle is in general of the same order of magnitude, and vanishes identically when $P < 1$ and ω is greater than the gyrofrequency of the ions. If the ions move with the Alfvén velocity, one has a reson ance with an infinitely great loss of energy by radiation. In reality e will be damping because of the finite conductivity. Assuming $N_2 = 10^7$ particles (per cm^2 of the beam), the above formula in of $(Q + P - 1)/P(P - 1)^{1/2} \approx 1$ will give a relative loss of energy cm path of about 10^{-8}, which means that a particle has to travel ut 6 miles in order to suffer an energy loss of about 1%. This ppointingly small loss leads one to the conclusion that only in s of resonance measurable effects can be expected. It is cer- that the energy loss in the case of the resonance P = 1 will ex- l the value estimated above by several powers of ten. A detailed ussion of this resonance has to take into account finite conduc- y of the plasma.

537.56

5012 GROWTH OF SURFACE INSTABILITIES IN A LINEAR PINCHED DISCHARGE.

atham, J.A.Nation, F.L.Curzon and A.Folkierski.
ure (London), Vol. 186, 624-5 (May 21, 1960).

Kerr cell photographs of a rapidly rising pinched discharge in on show surface instabilities qualitatively like Rayleigh—Taylor s. Observed growth rates are 50% of those calculated from ple theory. Plasma viscosity is estimated to be too small to ount for the predominant wavelength observed. R.S.Pease

537.56

15013 AN APPROACH TO THE QUESTION OF CONVECTIVE INSTABILITY OF A PLASMA.

Yu.A.Tserkovnikov.
l. Akad. Nauk SSSR, Vol. 130, No. 2, 295-8 (Jan.11, 1960).
ussian.

Three problems illustrating convective instability are investi- ed, using a hydrodynamical description of the plasma. In the first, plasma is at rest in a horizontal magnetic field; the instability erion obtained is a generalization of that for a horizontally strat- d armosphere. In the second, the two-stream instability of a o-temperature current-carrying plasma is considered. In the d, an instability depending on the flow of heat at right angles to agnetic field and a temperature gradient is considered.

O.Penrose

537.56

15014 HYDROMAGNETIC STABILITY OF A DIFFUSE LINEAR PINCH.

W.A.Newcomb.
. Phys. (New York), Vol. 10, No. 2, 232-67 (June, 1960).

The hydromagnetic energy principle is applied to the derivation necessary and sufficient conditions for the hydromagnetic stability linear pinch with distributed plasma current (a diffuse linear ch). The results are quite general in that the axial and azimuthal nponents of the magnetic field, which determine the structure of pinch completely, are treated as arbitrary functions of distance m the axis. For purposes of illustration, the general results are lied to the limiting case of a pinch with the plasma current con- ed to an infinitely thin layer (a sharp pinch).

537.56

15015 THE STABILITY OF A THIN RING-SHAPED PLASMA CONDUCTOR IN A MAGNETIC FIELD.

Yu.V.Vandakurov.
tekh. Fiz., Vol. 38, No. 3, 330-7 (March, 1960). In Russian.

This paper treats the stability theory of a toroidal pinched ctric discharge surrounded by a conducting toroidal tube. The is treated as an incompressible perfectly conducting fluid. The romagnetic stability equations are set up in a suitable coordinate tem and solved by treating as small the ratio of the two radii of plasma ring. The results are therefore qualitatively similar to se for a cylindrical discharge. O.Penrose

537.56

15016 PLASMA STABILITY AND BOUNDARY CONDITION.

F.C.Hoh.
ys. Rev. Letters, Vol. 4, No. 11, 559-61 (June 1, 1960).

Briefly discusses certain problems (e.g. limits of the classical ory) relating to the diffusion of charged particles across a mag- ic field. Instability of the wall sheath is invoked. J.D.Craggs

537.56

15017 AXIAL STABILITY AND LOCALIZATION OF CONSTRICTIONS OF QUASI-NEUTRAL PLASMA CELERATED BY ELECTROMAGNETIC FIELDS.

G.A.Askaryan.
nuclear Energy, Vol. 9, No. 1-4, 107-11 (June, 1959). English nslation of article in: Atomnaya Energiya, Vol. 4, No. 1, 71 58).

Calculates the axial stability conditions and the time-average ces on a cylindrically symmetrical plasma placed in a cylindrical waveguide and subjected to alternating electromagnetic fields. Includes terms allowing for electron-plasma oscillations and for energy dissipation by dipole radiation from the plasma.

R.S.Pease

537.56

15018 ON BOGOLIUBOV'S KINETIC EQUATION FOR A SPATIALLY HOMOGENEOUS PLASMA.

A.Lenard.
Ann. Phys. (New York), Vol. 10, No. 3, 390-400 (July, 1960).

An integral equation, proposed by Bogolyubov ["Problems of Dynamical Theory in Statistical Physics", Section 11. Moscow (1946). In Russian. (English translation by E.K.Gora, Air Force Cambridge Research Centre, Publication TR-59-235)], to determine the time development of the velocity distribution of a spatially homogeneous plasma is considered. It is shown that the time derivative of the velocity distribution can be expressed explicitly in terms of the distribution itself. The resulting kinetic equation has all the required properties, in particular, it satisfies the H-theorem. By means of an excellent approximation it can be reduced to that derived by Landau.

537.56

15019 EQUILIBRIUM PROPERTIES OF CLASSICAL ELECTRON GAS IN UNIFORM POSITIVE ION DISTRIBUTION.

Y.H.Ichikawa.
Progr. theor. Phys., Vol. 20, No. 5, 715-27 (Nov., 1958).

Thermal equilibrium properties of a classical electron gas are investigated by taking into account the plasma oscillation mode. The free energy is calculated in terms of collective coordinate representation. It is shown explicitly that the Debye—Hückel limiting term of the free energy is due to the short-range correlation part of the Coulomb interaction, and that the long range correlation effect increases the free energy by 22% of the Debye—Hückel term.

537.56

15020 STUDY OF A PLASMA COLUMN CONTINUOUSLY FED AND SUBJECTED TO AN ELECTROMAGNETIC FIELD: CONDITION FOR THE EXISTENCE OF NON-CENTRAL MAXWELLIAN SOLUTIONS: EQUATIONS FOR THE DENSITIES.

J.M.Dolique.
C.R.Acad. Sci. (Paris), Vol. 250, No. 7, 1221-2 (Feb. 15, 1960).
In French.

A cylindrically symmetric plasma column in axial external electric and magnetic fields is considered. To maintain a steady state against radial diffusion, a cylindrical ion and electron source on the axis is postulated. A condition, based on the Fokker—Planck equation, is formulated for both ions and electrons to have Maxwellian velocity distributions with uniform equal temperatures but non-uniform drift velocities. This condition can be used to determine the spatial distribution of electrons and ions.

O.Penrose

537.56

15021 STUDY OF A PLASMA COLUMN CONTINUOUSLY SUPPLIED AND SUBJECTED TO A MAGNETIC FIELD: FIRST-ORDER APPROXIMATION FOR THE DIFFUSION VELOCITIES; MANIFESTATION OF A FRONTIER ZONE.

J.M.Dolique and M.Y.Bernard.
C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1458-9 (Feb. 22, 1960).
In French.

The equations given in a previous paper (see preceding abstract) are simplified by assuming electrical neutrality and then solved as a power series in the ratio of maximum gas pressure to maximum magnetic pressure. This yields formulae for density as a function of position and for the radius of the plasma column. The diffusion velocities are calculated to first order and found to be equal except in a "frontier zone", of thickness comparable with the ion Larmor radius, in which the simplifying approximation of electrical neutrality breaks down. O.Penrose

537.56

15022 PLASMA VISCOSITY IN A MAGNETIC FIELD.

A.N.Kaufman.
Phys. of Fluids, Vol. 3, No. 4, 610-16 (July-Aug., 1960).

The viscosity of a fully ionized plasma in a magnetic field is analysed from two points of view: first, from a consideration of particle orbits; and second, from the solution of a simplified Boltzmann equation. These semiquantitative methods are studied in order to clarify the behaviour of the viscosity coefficients.

537.56

15023 DIFFUSION PROCESSES IN A PLASMA COLUMN IN A LONGITUDINAL MAGNETIC FIELD.

F.C.Hoh and B.Lehnert.

Phys. of Fluids, Vol. 3, No. 4, 600-7 (July-Aug., 1960).

Earlier results, by Lehnert, on the diffusion processes in the positive column in a longitudinal magnetic field have been confirmed in a new series of measurements over a wide range of data. Experiments with helium, argon, krypton, nitrogen, and hydrogen are described. In the case of helium good agreement is obtained between the collision diffusion theory and the experiment up to a certain critical magnetic field. For stronger fields the potential drop along the column indicates a much higher diffusion rate across the magnetic field than that expected from the binary collision theory. Account is taken, in the theory, of the presence of molecular ions and of charge exchange collisions. Abnormal voltage characteristics indicating an increased diffusion rate above a certain magnetic field strength have also been investigated in argon, krypton, nitrogen, and hydrogen. The transition from the normal to the abnormal branch of the characteristics seems to depend neither on the length of the discharge tube nor on the length of the magnetic field, provided that these lengths exceed some fifty tube diameters. On the other hand, the transition depends upon the gas density, the nature of the gas, the tube radius, and, also slightly, upon the discharge current. The transition is also indicated by an increasing noise level above the transition point. Finally, the product of the magnetic field strength and the tube radius seems to be constant at this point.

537.56

15024 ENERGY LOST TO RADIATION IN A GAS DISCHARGE PLASMA. V.D.Kirillov.

Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1142-4 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 812-13 (April, 1960).

Describes measurements of the radiation loss with a vacuum u.v. spectrometer and a vacuum thermoluminophor, and of the particle loss with a Langmuir probe in the plasma of a discharge (13.5 and 34 kA maximum; half-period: 500 μsec) in hydrogen (at a pressure of 10 μ Hg) in a straight porcelain tube (length 70 cm, bore 22 cm) with initial stabilizing fields of 0-24 kG. Concludes that the greater part of the energy fed to the plasma is lost as radiation, mostly within the wavelength range 1100-1400 A. Lyman radiation is only a small proportion of this. R.S.Pease

537.56

15025 ENERGY LOSS BY RADIATION IN A GAS-DISCHARGE PLASMA. V.D.Kirillov.

Zh. tekh. Fiz., Vol. 30, No. 3, 320-9 (March, 1960). In Russian.

Experiments are described elucidating the mechanism of energy loss from a stable plasma column, isolated from the walls of the container. The experiments were carried out in a cylindrical porcelain apparatus with electrodes. The discharge currents were a few tens of kiloamperes, the longitudinal field up to 24 kilogauss and the deuterium pressure from 0.01 to 0.2 mm Hg. The half period of the discharge current was about 500 microseconds. The flow of charged particles to the walls was found to be small. Experiments with an ionization chamber, a vacuum spectrograph, and a method based on the phosphorescence of $CaSO_4$:Mn showed that a significant part of the energy is carried away by ultraviolet radiation from impurities. O.Penrose

537.56

15026 RADIATION LOSSES IN COMPLETELY IONIZED PLASMA. J.Kvasnica.

Czech. J. Phys., Vol. 10, No. 1, 14-21 (1960).

The losses caused by bremsstrahlung during electron—ion and electron—electron collisions in a completely ionized plasma (in Born's approximation) are calculated. The calculation can be carried out analytically for a sufficiently dilute plasma (plasma with infinitely large Debye—Hückel radius). This assumption is satisfied very well by the known classification to an actual controlled thermonuclear reaction. A dependence of the form

$$I = an^2\sqrt{\tau}(1 + 3/\sqrt{2\tau}),$$

where $a = 0.73 \times 10^{-16}$ MeV cm^3 sec^{-1}, n is the number of ions per cm^3 and $\tau = kT/mc^2$, is determined for the amount of energy radiated from 1 cm^3 of plasma per sec. In the relativistic temperature region $kT \cong mc^2$, the influence of electron—electron collisions begins to predominate.

537.56 : 539.

BROADENING OF SPECTRAL LINES IN A STRONGLY IONIZED PLASMA. See Abstr. 13417

537.

15027 HEATING OF POSITIVE IONS IN A THERMONUCLEA PLASMA. H.M.Mott-Smith.

Nuclear Sci. Engng, Vol. 5, No. 1, 68 (Jan., 1959).

A possible mechanism for the transfer of energy from an externally accelerated electron beam is through the excitation of plasma waves whose group velocity is small or zero relative to th tube. In this case the achievement of high yields does not depend whether the velocity distribution becomes isotropic during the tim of the discharge. P.Gr

537.

15028 MEASUREMENT OF THE CONCENTRATION OF CHARGES IN A PLASMA BY THE METHOD OF A S.H. PROBE. S.M.Levitskii and I.P.Shashurin.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 948-51 (1959). In Russian.

An attempt was made to measure the local concentration of electrons by introducing into the plasma the s.h.f. oscillating syste The results of measurements were affected by ionic layers develop ing at the surface of the s.h.f. probe. If these effects could be removed or taken into account by calculation, there would be a new s.h.f. method, better than that of a hollow resonator, for investigati the plasma. Z.Krasuc

537.

15029 DEVELOPMENT OF THE IMPULSE S.H.F. DISCHARG IN INERT GASES. V.E.Golant.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 952-7 (1959). In Russian.

The mean frequency of ionization of gas atoms by electrons is calculated for krypton and xenon. Hence the critical field strength are calculated for the development of the impulse s.h.f. discharge i inert gases. The calculated critical field strengths are compared with experimental results. Z.Krasuc

537.

15030 NEGATIVE ELECTRICAL CONDUCTIVITIES. J.Schneider.

Z. Naturforsch., Vol. 15a, No. 5-6, 484-9 (May - June, 1960). In German.

The complex h.f. conductivity σ of a plasma in a magnetic fiel has been calculated on the basis of the Boltzmann transport equati Negative values of the real part of σ can occur, if the system is in a state of overpopulation, i.e. if $\partial f_0/dp > 0$, where f_0 is the momentum distribution function of the free carriers. Furthermore, the collision frequency or the mass of the carriers must be dependent on the momentum p.

537.

15031 MOTION OF A PLASMA LOOP IN AN AXIALLY SYMMETRIC MAGNETIC FIELD. L.M.Kovrizhnykh.

Zh. eksper. teor. Fiz., Vol. 36, No. 6, 1834-8 (June, 1959). In Russian. English translation in: Soviet Physics—JETP (New York) Vol. 36(9), No. 6, 1308-11 (Dec., 1959).

Calculates the axially symmetrical motions of a compressible conducting loop in a magnetic field. The equations include the effe of the loop mass, inductance and resistance, and of the finite numb of (non-relativistic) electrons carrying the loop current. Plasma pressure, finite Larmor radii and electrostatic effects are neglect and the small radius of the loop is supposed fixed. General featur of the equations are discussed, and the motions of the loop in r.f. d.c. mirror fields are calculated. Conditions for bounded motions are deduced. R.S.Pea

537.

15032 EXPERIMENTS ON PLASMOID MOTION ALONG MAGNETIC FIELDS.

D.M.Wetstone, M.P.Ehrlich and D.Finkelstein.

Phys. of Fluids, Vol. 3, No. 4, 617-30 (July-Aug., 1960).

Time-integrated photographs are presented of collimated plasmoid motion parallel to magnetic fields, into and around magnetic flux diverters, into and out of magnetic mirrors, and along curved fields. Field strengths up to 3 Wb/m^2 were employed. Th material projected along the field lines was substantially copper plasma, created by short vacuum spark bursts (plasmoids), and injected into a vacuum chamber. Flux diverters and nonuniform enoids expanded or compressed the plasmoid, which followed field lines. In the case of curved fields, at least parts of the smoid appeared to be guided by the field lines, the guidance proving with decrease in plasmoid density. In general the be-iour was more complicated than with straight geometries ause of the presence of internal polarization fields. Photo-ltiplier studies were employed with some geometries to estimate tre of mass and expansion velocities which, in later experiments, ched 5.5 and 1.9 cm/μsec. The latter figure gives an upper nd to ion temperature of 120 eV for copper. This ion energy considerably higher than those normally encountered in spark nnels and is a substantial fraction (0.12) of the axial energy. nechanism is described for achieving such a thermal energy ough the interaction of a strong shock wave with the initial dis-rge channel, thermalizing a large fraction of the axial energy. e upper bound for ion Larmor radius was that of the plasmoid. order to extend the wellknown treatment of the mirror reflection enomenon to such a dynamical plasma, a theoretical total reflec-n coefficient is derived for a plasmoid entering a magnetic mirror. e experimental equipment is described, and a machine-computa-nal method is outlined for mapping the flux distribution and sity in a wide variety of solenoid geometries and combinations

537.56

15033 EXPERIMENTAL PLASMA FLOW INTO A VACUUM MAGNETIC CUSP FIELD. R.F.Scott and R.F.Wenzel.

ys. Rev., Vol. 119, No. 4, 1187-8 (Aug. 15, 1960).

A direct dense plasma has been observed to penetrate and detained by a vacuum cusp magnetic field A gross measurement the directed velocity of the deuterium plasma was .5 ± 0.5) × 10^6 cm/sec. Ion density in the central region of the sp was measured to be 8.5 × 10^{15} at 16 μsec after injection and d a decay constant of 13.5 μsec. Magnetic probe measurements e shown which indicate the gross reaction of the magnetic field the injected plasma. Observation of impurity emission indicates at the plasma electrons cool rapidly and that the collision-domi-ted plasma is in contact with the container walls at the cusp ng.

537.56

15034 PLASMA PROPULSION BY A RAPIDLY VARYING MAGNETIC FIELD. M.M.Klein and K.A.Brueckner.

appl. Phys., Vol. 31, No. 8, 1437-48 (Aug., 1960).

An investigation has been made of the motion of a plasma under e action of a rapidly varying magnetic field from a stationary coil. he analysis has been done for two cases: (1) the plasma is assumed ompletely diamagnetic so that the ionization of the plasma may be nored and (2) the nondiamagnetic case where the ionization process s considered in detail. For the diamagnetic case the analysis yields coupled set of nonlinear ordinary differential equations which have een put in similarity form and solved for a wide range of the simi-arity parameters. An illustrative example is given to show how to se the results to obtain detailed information for a given physical ystem. The calculations indicate that, for field frequencies of about ne megacycle, velocities of the order 10^7 cm/sec may be attained, ut the efficiency of conversion of stored energy into kinetic energy s rather low (about 5-10%) and cannot be varied much by possible hanges in the physical and geometrical parameters of the system. ecause of the complexity of the analysis, a systematic series of olutions has not been made for the nondiamagnetic case. Instead, typical example has been worked out to indicate the major differ-nces to be expected. The results show that the nondiamagnetic lamsa yields an efficiency slightly less than that obtained for the orresponding diamagnetic plasma. The ionization process inside the lasma levels off very rapidly so that the electron density increases y only a few per cent during the motion of the plasma, but the mount of ionization has very little effect upon the efficiency of the ystem. The indications are that the efficiency of a plasma driven by magnetic field from a stationary coil is probably too low for ractical applications.

537.56

15035 THE THEORY OF PROBES. N.P.Generalov.

nuclear Energy, Vol. 9, No. 1-4, 148-51 (June, 1959). English ranslation from: Atomnaya Energiya Vol. 4, No. 3, 183 (1958).

Derives expressions for the electric field in the boundary layer urrounding the probe. C.G.Morgan

537.56

15036 WALL PROBE IN A MAGNETIC FIELD. I.K.Fetisov.

Zh. eksper. teor. Fiz., Vol. 36, No. 4, 1110-18 (April, 1959). In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 36(9), No. 4, 789-94 (Oct., 1959).

Calculates the current from a plasma for the case of infinite plane parallel geometry, with a uniform field perpendicular to the planes. The probe is a circular disc coincident with one of the bounding planes, which are themselves considered as metal surfaces separated by a distance small compared to collision mean free paths. The plasma is supposedly created by the ionization of neutral gas by a beam of fast ions. General equations are given, together with analytic solutions for asymptotic cases. The expressions should allow determination of the principal plasma parameters, and the diffusion coefficient perpendicular to the magnetic field, from the probe characteristics. R.S.Pease

537.56

15037 EXPERIMENTS ON THE ELECTRODYNAMIC ACCELERATION OF A PLASMA.

I.F.Kvartskhava, R.D.Meladze and K.V.Suladze.

Zh. tekh. Fiz., Vol. 30, No. 3, 289-96 (March, 1960). In Russian.

Experiments using an accelerator with coaxial electrodes, and another without electrodes, are described. Photographs taken during the experiments are exhibited and discussed. They show that in the coaxial accelerator three different groups of "lumps" of plasma may arise, a main group and two small ones apparently due to end effects. For both accelerators the optimal velocities of the accelerated plasma lumps are determined. For the coaxial accelerator the total mass of plasma accelerated per cycle is estimated. Qualitative explanations for the various observed effects are given. O.Penrose

537.56 : 538.3

15038 MAGNETOHYDRODYNAMICS OF A TERNARY PLASMA AND ASSOCIATED TYPES OF WAVE.

P.Cavaillés, R.Jancel and T.Kahan.

C.R.Acad. Sci. (Paris), Vol. 250, No. 23, 3789-91 (June 8, 1960). In French.

The hydrodynamical equations for a gas of electrons, positive ions, and neutral atoms, derived in a previous paper (Abstr. 12603 of 1960), are linearized and combined with Maxwell's equations. The resulting dispersion relation for wave propagation has the form of a twelfth-order determinant. O.Penrose

537.56 : 538.3

15039 SOME MAGNETOHYDRODYNAMIC EFFECTS OBSERVED ON IMPULSIVE COMPRESSION OF A PLASMA. I.F.Kvartskhava, K.N.Kervalidze and Yu.S.Gvaladze.

Zh. tekh. Fiz., Vol. 30, No. 3, 297-305 (March, 1960). In Russian.

Drum camera photographs of an impulsively compressed plasma in a strong magnetic field are presented and discussed. They indicate the presence of an instability of the plasma, in which a plasma formation (plasmoid) is thrown out of the surface of the pinched column. This ejection apparently results from the interaction of a radially expanding shock wave, reflected from the axis of the pinch, with the surrounding magnetic field. The effect can be observed both in a linear and in an inductive (theta-) pinch. Some probe measurements of the magnetic field are presented and discussed. The paper ends with a theoretical discussion indicating that compression velocities above about 10^7 cm/sec are impracticable in the inductive pinch. O.Penrose

537.56

15040 VIBRATIONS OF A THIN TOROIDAL PLASMA THREAD IN A MAGNETIC FIELD. Yu. V.Vandakurov.

Zh. tekh. Fiz., Vol. 30, No. 6, 711-22 (June, 1960). In Russian.

The axi-symmetric vibration of a thin toroidal plasma thread without dissipative resistance is considered in the magnetohydrodynamical approximation. The compressibility of the plasma is deduced. The oscillation frequency of the plasma is found both in the presence and absence of a perfectly conducting container. Threads departing slightly from toroidal form are then considered; this calls for variations in the containing magnetic field. It is shown that any radial component of the field in the plane containing the axis of the thread leads to a worsening of the conditions of stability. A.E.I.Research Laboratory

537.56

15041 THE EFFECT OF THE LANGMUIR LAYER BETWEEN PLASMA AND TUBE WALL ON WAVE PROPAGATION IN A "PLASMA CABLE". W.O.Schumann.
Z. angew. Phys., Vol. 12, No. 7, 298-300 (July, 1960). In German.

Discusses analytically the propagation of e.m. waves in a long plasma ("plasma cable") and in particular refers to the boundary sheath at the junction of the plasma and the tube wall. J.D.Craggs

537.56

15042 EXCITATION OF WAVES IN A PLASMA. A.G.Sitenko and Yu.A.Kirochkin.
Zh. tekh. Fiz., Vol. 29, No. 7, 801-7 (July, 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 7, 723-9 (Jan., 1960).

The excitation of waves by a current flowing outside the plasma is considered, using a two-component plasma theory which applies at all frequencies. The result is expressed in terms of refractive indices for the ordinary and extraordinary waves. A.H.Gabriel

537.56

15043 HIGH FREQUENCY OSCILLATIONS IN BOUNDED PLASMA.
R.A.Demirkhanov, A.K.Gevorkov, A.F.Popov and G.I.Zverev.
Zh. tekh. Fiz., Vol. 30, No. 3, 306-14 (March, 1960). In Russian.

Details are given of an experimental investigation into the mechanism of oscillations with frequencies between 10^2 and 10^3 Mc/s excited in the plasma bounded by double ionic layers. It was found, using a tube similar to the one employed by others (see Abstr. 4739 of 1954), that the oscillations were due to secondary electrons oscillating in a potential well formed in the plasma by the double ionic layers at its boundaries. The observed frequencies were below plasma frequency and were approximately equal to the frequency of the oscillating electrons. It is suggested, in the theoretical discussion of the effect, that the oscillating electrons in potential wells may be responsible for some processes originating in plasmas, such as the establishment of a Maxwellian distribution of velocities, the electromagnetic radiation etc. J.M.Zarzycki

537.56

15044 EXPERIMENTAL TWO-BEAM EXCITATION OF ELECTRON OSCILLATIONS IN A PLASMA WITHOUT SHEATHS. M.J.Kofoid.
Phys. Rev. Letters, Vol. 4, No. 11, 556-7 (June 1, 1960).

Standing waves of longitudinal electron oscillations have been excited in a plasma by two oppositely directed electron beams. There were no sheaths on the plasma boundary which the electrons crossed, in contrast to the experiment of Looney and Brown (Abstr. 4739 of 1954). D.Walsh

537.56

15045 COMPRESSION WAVES IN A PLASMA IN A STATIC MAGNETIC FIELD. N.Anderson.
Proc. Phys. Soc., Vol. 75, Pt 6, 905-12 (June, 1960).

The propagation of small-amplitude compression waves through a plasma in a static magnetic field is discussed. In contrast to the usual treatment of this type of problem the ions are not treated as a fixed neutralizing background but are included in the dynamics of the problem. The problem is discussed in the general case in which the thermal velocity distribution is not negligible. The method of solution is to use the linearized Boltzmann equation in conjunction with Maxwell's equations to obtain a distribution function and dispersion relation. To obtain the dispersion relation an approximation method is used and it is shown that over the greater part of the frequency range the oscillations are of a characteristic wave-number. It is shown that the inclusion of the ions in the dynamics is justified by the fact that at integral multiples of the ion gyrofrequency the ions play the dominant role. The results obtained show that the waves are undamped. The graph of the distribution function for particles with large velocities shows a fine structure which indicates that at these velocities collisions become important, especially for particles moving perpendicular to the field and direction of propagation.

537.56

15046 OBSERVATION OF ION CYCLOTRON WAVES. T.H.Stix and R.W.Palladino.
Phys. of Fluids, Vol. 3, No. 4, 641-7 (July-Aug., 1960).

The existence of ion cyclotron waves had been inferred from theoretical calculations and indirectly from experimental observations. Direct experimental observations are reported of phenomena appropriate to these waves in a hot plasma. An induction coil energized at 11.5 Mc/s with approximately 200 000 W of r.f. power surrounds a deuterium plasma confined in a 16 kG magnetic field. A single-turn r.f. magnetic probe located in the plasma about 50 cm down the axis from the centre of the induction coil is used to detect the propagated wave. The probe is movable. Radial motion of the probe shows the expected penetration of the transverse r.f. field int the centre of the plasma. Axial motion of the probe shows a 300 cm damping length, and an oscillation wavelength 64% longer than the calculated value. The probe signals disappear when the ion cyclotron frequency is less than the induction coil frequency, which is a result predicted from the ion cyclotron wave dispersion relation.

ELECTRON EMISSION
ELECTRON BEAMS

537.533 : 539.2 : 548.

THERMIONIC WORK FUNCTION OF EuB_6. See Abstr. 14012

537.53

15047 DETERMINATION OF THE ELECTRON WORK-FUNCTION FOR MACROSCOPIC TUNGSTEN CRYSTAL FACES. H.Gienapp.
Z. angew. Phys., Vol. 12, No. 6, 254-7 (June, 1960). In German.

The work function was determined by finding the variation of thermionic emission with temperature, for the (111), (001), (011), and (112) faces. The significance of its variation with direction is discussed. A.R.Stoke

537.53

15048 INVESTIGATION OF THE ELECTROSTATIC EMISSION OF ELECTRONS FROM A TUNGSTEN EMITTER IN TH IMPULSE REGIME. I.I.Gofman, O.D.Protopopov and G.N.Shuppe.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1323-7 (June, 1960). In Russian.

Volt-ampere characteristics are determined with a measuring system carefully revised to eliminate inaccurate aspects permitted by earlier authors. The results clearly favour one out of three possible theoretical explanations. A.E.I. Research Laborator

537.53

15049 MEASUREMENTS OF THE CHARGE-CARRYING EMISSION DUE TO THE INFLUENCE OF GASES ON FRESHLY PREPARED ALUMINIUM SURFACES.
K.Ulmer and M.Zimmermann.
Naturwissenschaften, Vol. 47, No. 11, 250 (1960). In German.

Liquid Al is prepared in a graphite crucible in high vacuum, th experimental arrangement being designed so as to maintain a clean meniscus. A time-dependent exo-electron emission from this meniscus is observed when certain gases (O_2 and an N_2-O_2 mixture in t proportions of 40 : 1) are admitted to the system, but other gases (N_2, A) produce no measurable effect. The initial exo-electron emission current I obeys a relationship of the form $I \propto \exp(-\epsilon/kT)$, where ϵ is a constant (~ 0.7 eV) and T is the absolute temperature of the Al specimen. The current I is also shown to be directly proportional to the oxygen partial pressure over a range of more than three orders of magnitude. C.H.B.Me

537.533 : 539.2 : 537.

ELECTRON TRANSFER AND ONSET OF FIELD EMISSION IN RUTILE SINGLE CRYSTALS. See Abstr. 13579

537.53

15050 THE SIMULATED THERMALLY EXCITED CO-ELECT EMISSION OF HYDRATES. B.Sujak and A.Bohun.
Acta phys. Polon., Vol. 18, No. 5, 419-25 (1959). In German.

Dehydration—temperature curves were measured by means of t resulting electron emission for hydrates such as $Na_2SO_4.10H_2O$ $BaCl_2.2H_2O$, $Na_2S_2O_3.5H_2O$ and $CuCl_2.2H_2O$ using an atmospheric spark counter. It is shown that when a heating unit of small therma capacity is used, the required linearity of warming is upset at the emission peaks by the endothermic nature of the dehydration proces G.F.J.Garlick

537.533

15051

THE APPLICATION OF THERMIONIC EMISSION FOR DIRECT TRANSFORMATION OF THERMAL INTO LECTRIC ENERGY.

N.D.Morgulis and A.G.Naumovets.

iz. tverdogo Tela, Vol. 2, No. 3, 537-42 (March, 1960). In Russian.

Describes experiments on a fairly simple arrangement of a mm diameter tungsten sponge cathode and 1.5 mm diameter anode ith a guard ring), with 2 mm interelectrode spacing, in caesium apour. This makes use of partial compensation of the electron ace-charge by Cs ions, produced as a result of thermal ionization bare regions of the metal surface. Appreciable short-circuit cur- ents can be obtained, approaching the saturation value. Caesium ns arriving at the surface of the cooler anode produce a film with lower work function than the cathode. For a cathode temperature 1300°C the maximum available power was 0.6 W/cm², the ficiency being about 5%. R.Berman

537.533 : 621.385.032.213.13

15052

NONLINEAR EFFECT UPON THE EQUIVALENT CIRCUIT OF INTERFACE IMPEDANCE IN PULSE METHODS.

Tamiya.

ev. sci. Instrum., Vol. 31, No. 7, 786-8 (July, 1960).

Shows that the non-linear characteristic of the test diode intro- uces spurious RC-elements into the equivalent circuit. Therefore, r a layer with multiple time constants the "apparent" RC-elements iffer from the true ones. A.H.W.Beck

537.533

15053

OBSERVATIONS ON EXO-ELECTRON PROBLEMS.

H.Birgfellner.

cta phys. Austriaca, Vol. 13, No. 2-3, 293-9 (1960). In German.

The X-ray induced exo-electron emission of etched metals sually decreases in magnitude if a surface layer of 25-50μ thickness s removed. Only in one case of a steel was emission found from roughout the 0.6 mm thick specimen. This emission appears to be ssociated with defects due to lead impurity. Oxygen inclusions nfluence the magnitude of exo-electron "glow" curves for freshly tched steel and nickel iron specimens as observed by Grunberg and right (see Abstr. 3305 of 1956). G.F.J.Garlick

537.533 : 621.383

15054

ABSOLUTE SPECTRAL RESPONSE CHARACTERISTICS OF PHOTOSENSITIVE DEVICES.

R.W.Engstrom.

C.A. Rev., Vol. 21, No. 2, 184-90 (June, 1960).

Data are presented comparing absolute response character- stics associated with the various commercial-type photocathodes. table is provided of luminous sensitivity, dark emission, and quan- um efficiency typical of these photocathodes. Some similar data re presented for photoconductive devices.

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15055

PHOTOELECTRIC EMISSION FROM COPPER AND SILVER IODIDE.

Yu.A.Shuba and I.V.Smirnova.

iz. tverdogo Tela, Vol. 2, No. 6, 1321-2 (June, 1960). In Russian.

Briefly describes measurements of the (relative) quantum fficiency of CuI and AgI layers as open photomultipliers in the avelength range 2600 to 1100 A. A replica diffraction grating as used to select the required spectral region and a fluorescent ethod was used to measure relative quantum efficiency. The esults show that in the energy range 7-11 eV there is little to hoose between the two materials but between 5 and 7 eV the copper odide surface is superior by several orders of magnitude. T.Mulvey

537.533

15056

THE EFFECT OF ALKALI METALS ON THE PROPERTIES OF ANTIMONY PHOTOCATHODES.

Yu.A.Nemilov and V.E.Privalova.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1308-15 (June, 1960). In Russian.

The spectral characteristics and sensitivity of Sb—Li, Sb—K—Na, Sb—Na, and Sb—K photocathodes were studied in relation o the Na/K and Sb/M ratios. where M denotes the total alkali etals content. It was found that the position of the selective maxi- um on the photocurrent spectrum is determined by the preponder- ant alkali metal. With decreasing Na/K ratio in the Sb—Li and Sb—K—Na photocathodes their sensitivity increased in the former and decreased in the latter case. M.H.Sloboda

537.533 : 621.383.27

15057

PHOTOMULTIPLIER DEVELOPMENTS.

Nucleonics, Vol. 18, No. 5, 90-1 (May, 1960).

A review of papers presented at the 1960 Scintillator Counter Symposium in Washington. Tubes have been developed for high temperature operation using silver—magnesium dynodes operating at high voltage. Other tubes have short rise times (~ 2 mμsec) or very high signal-to-noise ratios. R.D.Smith

537.533

15058

SECONDARY ELECTRON EMISSION OF ICE AND ANTHRACENE FILMS.

T.L.Matskevich and E.G.Mikhailova.

Fiz. tverdogo Tela, Vol. 2, No. 4, 709-15 (April, 1960). In Russian.

The dependence of the coefficient of inelastic scattering and of the coefficient of secondary electron emission on the primary electron energy (U_p) was measured for ice, anthracene and Mo in a special apparatus which is described and illustrated; similarly the dependence of both coefficients on the time during which the film of ice or anthracene was produced. The measurements were carried out in the U_p range between 200 and 2500 eV at -180°C. Comparison of results obtained for $C_{14}H_{10}$ with those obtained by one of the authors (Matskevich) for polyethylene and polystyrene indicate that, as regards the properties of secondary emission, the dielectric substances with the molecular type of bonding can be considered as forming one close group. F.Lachman

537.533

15059

SECONDARY EMISSION FROM AN INCANDESCENT METAL DUE TO THE ACTION OF CAESIUM AND POTASSIUM IONS.

N.N.Petrov.

Fiz. tverdogo Tela, Vol. 2, No. 5, 949-58 (May, 1960). In Russian.

A hot molybdenum target was bombarded with caesium ions with energies E from 0.2 to 1.4 keV. A linear increase in the coefficient γ was found in the interval E = 0.3 to 1.4 keV, being less than 0.1% with E = 0.2 keV. The spectrum of reflected ions contains fast positive particles with energy up to 110 eV when E = 1 keV, the appearance of which can be explained by a caesium ion hitting two atoms of molybdenum simultaneously. An intensity-modulated beam of K ions was used to study the secondary emission from tantalum and tungsten targets at temperatures up to 2000°K. No ejection of electrons is observed with ion energies less than 1.5 keV. The coefficient γ then increases linearly with ion energy up to 6 keV, the rate of increase being independent of the type of target and its temperature in the interval 1700-2000°K. D.E.Brown

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15060

INELASTIC SCATTERING OF ELECTRONS AND SECONDARY ELECTRON EMISSION OF ACTIVATED Cu—Al—Mg ALLOY IN THE PRIMARY-ELECTRON ENERGY-RANGE 0.5 TO 20 keV.

V.N.Lepeshinskaya and G.B.Stuchinskii.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1328-32 (June, 1960). In Russian.

The secondary emission and inelastic scattering coefficients of Cu—Al—Mg activated by a thin surface layer of MgO were measured for various primary electron energies. Inelastic scattering was found to contribute very substantially to total secondary emission. In monocrystalline MgO the secondary emission coefficient is inversely proportional to the primary energy, but in the case investigated this relationship only held for primary energies greater than 10 keV. Both coefficients depended markedly on the angle of incidence of the primary electrons. A.E.I.Research Laboratory

537.533

15061

THE EJECTION OF ELECTRONS FROM METALS BY IONS.

N.N.Petrov.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1300-7 (June, 1960). In Russian.

A ejection mechanism is proposed. This involves indirect excitation of bound electrons by ions suffering nearly elastic collisions with target atoms. For ions of less than a specified threshold energy this process is absent. Various factors affecting the value of the coefficient γ are also discussed.

A.E.I. Research Laboratory

537.533

15062

SECONDARY EMISSION BY TRANSMISSION.

H.Dormont and P.Saget.

J. Phys. Radium, Vol. 20, Suppl. No. 4, 23A-28A (April, 1959). In French.

The methods of obtaining thin multiple layers are described. These layers are produced by successive vacuum distillation of halides or oxides on thin metallic films. By studying the transmission secondary emission properties of these layers, the following results have been obtained: (1) aluminium films, 400 A thick, are the best metallic support; (2) alkali halide layers have large secondary emission coefficients (KCl, δ = 5) but are not stable; (3) oxide layers (MgO) are more stable. After operating for some time, they exhibit larger yields than the halide layers.

537.533

15063 ELECTRON-OPTICAL OBSERVATIONS OF THE "PATCH FIELDS" ON THE EMITTING SURFACES.

G.V.Spivak, I.A.Pryamkova and V.N.Lepeshinskaya.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 4, 751-4 (Feb. 1, 1960). In Russian.

After a short qualitative discussion of the "patch fields" (Abstr. 5506 of 1949), details are given of the observation of such fields in an electron mirror. The emitters (dynodes) were made of Cu—Al—Mg alloy. The retardation curves of the secondary electron current from the emitters at 20°K and 400°K are reproduced and their shape can be explained by the patch-field theory. The surface of the emitters was investigated optically and electronicaly. The probable characteristics of the patch fields is given.
J.M.Zarzycki

537.533 : 621.362

15064 CONTRIBUTION OF ANODE EMISSION TO SPACE CHARGE IN THERMIONIC POWER CONVERTERS.

A.F.Dugan.
J. appl. Phys., Vol. 31, No. 8, 1397-1400 (Aug., 1960).

The space charge theory of Langmuir has been extended to include the effects of anode emission on the performance of a vacuum thermionic power converter. The basic equation is similar to Langmuir's $\xi-\eta$ equation, but it involves two additional parameters which depend on the temperatures and thermionic properties of the electrodes. An iterative technique is described for obtaining solutions in specific cases, and some sample calculations based on hypothetical diodes are presented. The calculations indicate that the effect of the anode temperature is considerably more pronounced if the cathode—anode work function difference is large.

537.533 : 621.385.833

15065 THREE-DIMENSIONAL SPACE CHARGE FLOW.

J.Rosenblatt.
J. appl. Phys., Vol. 31, No. 8, 1371-7 (Aug., 1960).

The general theory of stationary beams of prescribed shape is developed taking into account the electrostatic interaction between the particles. The Hamilton—Jacobi equation, expressed in a particular system of coordinates, allows the determination of the potential distribution inside the beam. Compatibility conditions for the equations are obtained, as well as a general rule for the determination of the feasibility of arbitrarily chosen trajectories. A theoretical expression results for the proportionality coefficient k in Child's law ($J = kV^{3/2}$) which relates current density J with the potential difference V between electrodes. The theory was applied to the particular case of a plane beam with hyperbolic boundaries. The beam was experimentally reproduced, providing values for k in close agreement with the theoretical ones.

537.533 : 621.362

15066 GENERATION OF ALTERNATING CURRENT IN THE CESIUM CELL.

H.L.Garvin, W.B.Teutsch and R.W.Pidd.
J. appl. Phys., Vol. 31, No. 8, 1508-9 (Aug., 1960).

Oscillations of frequencies around 10^5 c/s were observed in a plane-parallel Cs diode used for energy conversion. The oscillations occurred in the constant current part of the characteristic. Experiments on the nature of the phenomenon are in progress.
A.H.W.Beck

537.533

15067 ON THE THEORY OF A PLASMA THERMIONIC ELEMENT.

B.Ya.Moizhes and G.E.Pikus.
Fiz. tverdogo Tela, Vol. 2, No. 4, 756-74 (April, 1960). In Russian.

A theoretical discussion of the physical phenomena. The main conclusions are: (1) for small Cs pressure and small inter-electrode distance the current is determined by diffusion, and the e.m.f. by the difference between the chemical potential of the plasma at the cathode and the work function of the anode; (2) for appreciable power the cathode temperature must be $>\sim 2100^{\circ}$K. The current drawn is roughly inversely proportional to the inter-electrode distance and is little dependent on pressure; (3) the temperature of the anode should be raised, but emission current must be $<\sim 0.1$ of current drawn (800°K for oxidized silver in Cs); (4) the power is little dependent on the work function of the cathode χ_k over a wide range. Cs pressure can be chosen to obtain the required χ_k with a W cathode; (5) raising the Cs pressure gives conditions (not of practical interest) approaching the isothermal plasma discussed in an appendix; (6) a plasma in thermodynamic equilibrium can only be achieved by a considerable increase in pressure, inter-electrode distance and anode temperature. The efficiency is reduced but thi regime can be used for studying the thermoelectric properties of the plasma.
R.Berm

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15068 NEGATIVE GLOW PLASMA AS A CATHODE FOR ELECTRON TUBES.

J.M.Anderson and L.A.Harris.
J. appl. Phys., Vol. 31, No. 8, 1463-8 (Aug., 1960).

The plasmas of the negative glow region of a cold-cathode discharge in helium and neon are examined for their ability to supply free electrons for operation of a "vacuum" amplifier tube. The plasma replaces the conventional oxide-coated hot cathode in a tub with closely-spaced fine-mesh grids. At gas pressures ~1 mm Hg the VA characteristics of the amplifier portion of the total dischar tube are essentially the same as found in the high-vacuum, hot-cathode counterpart. The noise content of the anode-current of the "glow-cathode" tube, defined by equivalent noise-diode current, wa examined from 50 kc/s to 50 Mc/s. At the lower frequency, this equivalent current is ~10 times the actual current flowing. At frequencies approaching 50 Mc/s the equivalent current drops to a factor ~0.5 and may be considerably lower for unexamined frequencies above 50 Mc/s.

537.533 : 621.385

15069 ANALOG STUDY OF LARGE-SIGNAL HIGH-FREQUEN DIODES.

C.L.Andrews.
J. appl. Phys., Vol. 31, No. 8, 1431-7 (Aug., 1960).

A rolling-ball analogue for the motion of electrons in a high-frequency longtiudinal field was developed in which the balls, injec at regular time intervals, plotted photographically a family of grap of distance against time, indicated the electron bunching, velocity modulation and density modulation. From these graphs the curren densities were found as a function of time for a series of equally spaced positions between cathode and anode, and the anode current induced by the electron stream was computed. Graphs of conductance against transit angle revealed that the conductance was indepe dent of the size of signal for indices of modulation 0.25, 0.50, and 0.75. When the transit angle was 2π the induced anode current was almost pure first harmonic plus d.c. When the transit angle was 3 the first harmonic disappeared.

537.533 : 621.385.

15070 THEORETICAL PROBABILITY TREATMENT OF ANO CURRENT VARIATIONS IN ELECTRON TUBES.

L.Takács.
Acta phys. Hungar., Vol. 7, No. 1, 25-50 (1957). In German.

The author comments on Schottky's (1918) solution of the prob of anode current variations in a thermionic diode, and shows that th solution can be generalized and an exact solution found for the nature of the noise spectrum.
A.E.I. Research Laborato

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15071 AN OBSERVATION ON THE PAPER "THEORETICAL PROBABILITY TREATMENT OF ANODE CURRENT VARIATIONS IN ELECTRON TUBES".

K.H.Löcherer.
Acta phys. Hungar., Vol. 8, No. 3, 361-2 (1958). In German.

A very brief theoretical note which refers to a previous paper by Takács (preceding abstract) with particular reference to reduct of fluctuations by space charge effects, etc.
J.D.Cragg

537.53

15072 EXAMINATION OF THE POSSIBILITY OF USING A NON-UNIFORM MAGNETIC FIELD FOR PRODUCTIO OF HIGH-DENSITY ELECTRON BEAMS.

Yu.V.Troitskii.
Zh. tekh. Fiz., Vol. 30, No. 5, 512-21 (May, 1960). In Russian.

Immersion of the cathode of a converging Pierce gun in a suitable magnetic field running along the mean electron trajectori focuses electrons leaving the cathode with thermal velocities and hence improves the compression and perveance of the gun. Experiment shows that the improvement is greatest for a series of well defined values of the magnetizing currents. Earlier theoretical pr diction are broadly confirmed.
A.E.I.Research Laborator

537.533 : 621.38

15073 HIGH-VOLTAGE ELECTRON EXTRACTION FROM AN ARC-DISCHARGE PLASMA.

K.G.Hernqvist.
R.C.A. Rev., Vol. 21, No. 2, 170-83 (June, 1960).

A method of using an arc-discharge plasma as an electron so for producing very high current-density electron-beams in vacuum is described. Electrons are extracted from a magnetically confined mercury-pool arc. A theoretical upper limit for the vapour ssure in the extraction region is derived, and results of tests on electrode configuration satisfying this pressure requirement are en. For a certain beam voltage, instabilities occur in the ex- cted current above a value of current density which can be ectly related to the 3/2-power law for the electron sheath in the raction region. Stable beams having current densities of A/cm^2 were obtained for beam voltages of 1 kV.

537.533 : 621.385.833

15074 PARTITION NOISE IN ELECTRON BEAMS AT MICRO-WAVE FREQUENCIES. A.Ashkin and L.D.White.

appl. Phys., Vol. 31, No. 8, 1351-7 (Aug., 1960).

A study was made at 4080 Mc/s of the partition noise introduced o a beam by a meshed grid as a function of its position along the am. Simultaneous information concerning the beam dynamics s obtained by means of a beam analyser. With cathode magnetic lds somewhat below those corresponding to immersed flow, the rtition noise exhibited sharp dips as the grid in moving along the am passed through the planes which corresponded to image planes the cathode. These observations confirm the picture of noise oothing taking place over relatively small areas in the vicinity the cathode and elucidate the contribution of the random inter- ption of electrons to the partition noise. With small cathode mag- tic fields the partition noise varied sinusoidally with the cyclotron riodicity as the grid was moved along the beam. This variation th position is thought to result from the contribution to the par- ion noise of higher-order mode conversion.

537.533

15075 ELECTROSTATIC FIELD OF AN ELECTRON LENS CONSISTING OF TWO COAXIAL CYLINDERS.

N.Lebedev and I.P.Skal'skaya.

tekh. Fiz., Vol. 30, No. 5, 472-9 (May, 1960). In Russian.

An electron lens is formed from a semi-infinite cylinder inside coaxial infinite cylinder. It is shown that the potential distribution n be represented by a pair of integral equations. A method of lving these is developed and applied to several particular cases.
A.E.I.Research Laboratory

537.533

15076 CALCULATION OF THE ELECTROSTATIC FIELD OF A SYSTEM OF PLANE DIAPHRAGMS WITH CIRCULAR PERTURES. G.A.Grinberg and E.N.Kolesnikova.

tekh. Fiz., Vol. 30, No. 6, 723-33 (June, 1960). In Russian.

Two parallel plane diaphragms contain circular holes. The rface distribution of charge induced on these diaphragms by a axial uniform ring charge was determined. The potential and eld distributions were deduced. The method of calculation can extended to determine the effect, on the diaphragms, of arbitrary isymmetric charge distributions. A.E.I.Research Laboratory

537.533

15077 PHYSICAL PRINCIPLES OF ELECTRON MICRO-SCOPICAL IMAGING METHODS. E.B.Bas.

hweiz. Arch. angew. Wiss. Tech., Vol. 26, No. 4, 138-56 (April, 60). In German.

The principles of electron guns and electron lenses are outlined d the way in which they are combined to form an electron micro- ope is described. The factors involved in image contrast and esolving power are discussed, as well as the advantages and limit- tions of the instrument. Related techniques of electron imaging are so briefly mentioned: reflection, emission and scanning micro- opes. An elementary survey of the subject, illustrated with many agrams and micrographs. V.E.Cosslett

537.533

15078 ASYMMETRIC IMAGES DUE TO MISALIGNMENT IN THE ELECTRON MICROSCOPE.

.Kanaya, A.Kato and I.Yamayi.

ull. Electrotech. Lab. (Tokyo), Vol. 22, No. 4, 281-98 (April, 1958). Japanese.

Asymmetric images due to the astigmatism caused by misalign- ents, such as the lateral shift and tilt of lenses, and by the inclination the incident electron beam, are theoretically treated. For the purpose obtaining practical data on high-resolution microscope design, study was made of a number of asymmetric images due to the dis- lacement between the objective and projective lenses by applying e deflecting field excited by the magnetic coil to the electron beam. heoretical and experimental results are in good agreement.

537.533

15079 NOTE ON: USE OF A PLATINUM FILAMENT IN THE ELECTRON MICROSCOPE, BY FRANCIS W. BISHOP.

M.von Ardenne.

Rev. sci. Instrum., Vol. 31, No. 8, 913 (Aug., 1960).

Refutes the claim made in Abstr. 3808 of 1960 that the point cathode described, in which a platinum wire point heated by Joule heat is covered with a mixture of electron-emitting oxides, is a novel invention.

537.533

15080 EMISSION MICROSCOPY WITH ION-RELEASED ELECTRONS. H.Düker.

Schweiz. Arch. angew. Wiss. Tech., Vol. 26, No. 5, 199-201 (May, 1960). In German.

A general account of an emission microscope developed for the direct observation of thermal effects in metals and alloys. The object, which is the cathode of an electrostatic immersion objective, is obliquely bombarded with positive ions from a gas discharge. The electrons released from its surface are imaged without distortion in two stages, the magnification range being 500 to 1600 times. Advantages of the microscope are that its resolution is independent of temperature and that specimens can be examined at temperatures between 20 and 1100°C. R.Reed

537.533

15081 SIMPLE THEORY CONCERNING THE REFLECTION OF ELECTRONS FROM SOLIDS. T.E.Everhart.

J. appl. Phys., Vol. 31, No. 8, 1483-90 (Aug., 1960).

A simple theory concerning the reflection of electrons from solid targets is derived, based on the following assumptions: (1) the primary cause of electron reflection from a solid material is Rutherford scattering through angles greater than 90°; (2) the energy loss of electrons penetrating a solid target is given by the Thomson--Whiddington law, or a modified version of it; (3) no multiple scattering is allowed. An expression for the reflection coefficient r is derived that agrees surprisingly well with experimental data, in view of the above simplifying assumptions. In particular, the correct variation of r with atomic number Z is obtained, and the observed value of the fractional escape energy is calculated in the limit as $Z \rightarrow 0$, where the theory is most accurate. A critical discussion of the simplifying assumptions is given, and the range of validity of the theory is estimated. This theory leads to a better understanding of the related phenomena of secondary emission at primary electron energies between 2 and 50 keV.

537.533

15082 ABSORPTION AND RANGE OF ELECTRONS IN A SOLID. A.Ya.Vyatskin and A.F.Makhov.

Fiz. tverdogo Tela, Vol. 2, No. 5, 887-93 (May, 1960). In Russian.

The experimental results of previous work (Abstr. 7115 of 1958) are analysed to obtain the absorption function and path length distribution for incident electron energies of 8-20 keV in Cu, Bi, Ge and Si. D.J.Huntley

537.533

15083 THE PARTITION OF ENERGY OF ELECTRONS OF MEDIUM VELOCITY TRAVERSING THIN LAYERS.

G.Syrbe.

Z Phys., Vol. 159, No. 2, 237-42 (1960). In German.

An approximate solution of the partial differential equation describing the energy partition of electrons passing through thin foils is obtained, and the resultant range—energy relation compared with measurements of the penetrability of electrons in aluminium and aluminium oxide. S.J.St-Lorant

ION EMISSION . ION BEAMS

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15084 DESIGN OF THE BASE AND RESULTS OF MEASUREMENTS ON THE HIGH-FREQUENCY ION SOURCE FOR A VAN de GRAAF ACCELERATOR.

E.Cilenšek, F.Cvelbar and V.Ramšak.

"J.Stefan" Inst. Rep., Vol. 4, 117-22 (Oct., 1957). In German.

A base of new design has been fitted to the ion source previously described ["J.Stefan" Inst. Rep., Vol. 1, 45 (1953)]. Measurements of the intensity of the ion beam and the proton component have been made in order to investigate the effect of the dimensions and cleanness of the metal surfaces in the discharge tube, of impurities in the hydrogen and of the coupling between oscillator and discharge tube. V.E.Cosslett

537.534

15085 PROOF OF THE EXISTENCE OF AN OPTIMUM PRESSURE IN THE INTERIOR OF A HIGH-FREQUENCY SOURCE WITH DIAPHRAGM GIVING POSITIVE IONS OF ARGON.

D.Blanc and A.Degeilh.
C.R.Acad. Sci. (Paris), Vol. 250, No. 20, 3313-15 (May 16, 1960). In French.

Using a previously described ion source (Abstr. 7911 of 1959) with various diaphragms from 0.4 to 3 mm diameter, measurements were made of the ion current I as a function of the gas pressure p in the source, and of the rate of flow R of gas through it. The results showed that for given accelerating and extracting fields, I was a maximum at $p = 2.15\ \mu$ Hg for all diaphragms; the value of I at the maximum increased with increasing R. J.Dutton

537.534

15086 FORCES ON ION-BOMBARDED ELECTRODES IN A LOW-PRESSURE PLASMA. G.K.Wehner.

J. appl. Phys., Vol. 31, No. 8, 1392-7 (Aug., 1960).

Forces arising on ion-bombarded electrodes have been measured with a torsion balance immersed in a low-pressure Hg plasma. The force curves obtained for 22 metals in the range of 20 to 300 eV bombarding energy indicate that Hg^+-ions are completely accommodated ($\alpha = 1$) on clean metal surfaces and the forces originate essentially from the ejection of sputtered atoms. Comparing the forces with the sputtering yields one obtains information on the average ejection velocities of sputtered atoms, which are found to be much higher than those of thermally evaporated atoms. Oxide-covered surfaces exhibit a quite different behaviour inasmuch as the accommodation coefficient for Hg^+-ions seems to be less than unity.

537.534

15087 STUDY AND REALIZATION OF A MASS SPECTROMETER OF THE OMEGATRON TYPE. APPLICATION TO LEAK DETECTION AND GAS ANALYSIS AT LOW PRESSURES.

R.J.Warnecke.
Ann. Radioelect., Vol. 15, 169-99 (April, 1960). In French.

For previous part see Abstr. 283 of 1960. After describing the Omegatron, the author gives a number of experimental results which show the influence of the principal parameters (h.f. level, polarization voltage, electron current intensity, electron accelerating voltage, pressure) on the performance of the spectrometer, two versions of which are described; one, is intended for the analysis of low-pressure gases (P not greater than 10^{-5} torr), and the other for the detection of leaks in relatively small containers in which high vacua can be obtained. Typical mass spectra are shown and figures given on the sensitivity and luminosity of the apparatus, and also on precision of measurement.

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CASCADED MASS SPECTROMETERS. PRINCIPLES OF A MAGNETIC RESONANCE DEVICE. See Abstr. 14157

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15088 RATIOMETER FOR LOW-CURRENT MASS SPECTROMETRY. F.D.S.Butement and N.P.Finkelstein.

J. sci. Instrum., Vol. 37, No. 9, 328-32 (Sept., 1960).

A new technique for the measurement of isotopic abundance ratios has been developed. Individual ions in the beam are detected, and an automatic switching device counts the total number of ions in each of the two mass beams being compared. The system is simple to operate and has been found to give very accurate results. No elaborate stabilization of ion-source emission or other operating conditions is necessary.

537.534

15089 A NOTE ON THE DEPENDENCE OF THE SPUTTERING PRODUCED BY BOMBARDMENT BY CANAL RAYS ON THEIR ANGLE OF IMPACT. V.T.Chiplonkar and B.N.Varadrajan.

Indian J. Phys., Vol. 33, No. 3, 127-34 (March, 1959).

The sputtering produced by bombardment of metal targets with canal rays has been observed to consist of two types I and II, appearing in the two characteristic angular regions of 0°-20° and 30°-90° respectively (with respect to the incident beam). There is evidence to show that the magnitude of sputtering as well as the angular intensity distribution in type I (which appears to be the significant one involved in the sputtering of wires) show a definite dependenc on the angle of impact, thus indicating that it involves a momentu transfer mechanism.

PARTICLE ACCELERATORS

537

15090 THE CALCULATION OF THE ELECTROMAGNETIC FIELD IN AN ALVAREZ TYPE LINEAR ACCELERATOR. F.Ford.

Proc. Cambridge Phil. Soc., Vol. 56, Pt 3, 252-68 (July, 1960).

A recently developed theory of the electromagnetic field in nearly periodic structures [Wild,E. Quart. J. Mech. appl. Math., Vol 10, 322-41 (1957)] is used to calculate the field in an Alvarez type linear accelerator. The problem is reduced to the solution the transmission line equations for the "voltage" and "current" o the dominant mode. Formulae are given for the coefficients in these equations, and also for the ratio of mode current to acceler ating field, as functions of the cavity dimensions of the accelerat numerical values are given for the Berkeley accelerator.

537.

15091 ON THE RELATIVISTIC ELECTRON OPTICS OF AN ELECTROSTATIC ACCELERATOR.

E.B.Bas, L.Preuss and W.Schneider.
Z. angew. Math. Phys., Vol. 10, No. 6, 533-43 (1959). In German.

Relativistic and nonrelativistic data for the coaxial two-cylin electrostatic electron-lens are compared. Values of the potential along the axis were measured on a resistance network analogue, whilst trajectories were calculated on a high speed digital comput Index R indicating relativistic values, and N nonrelativistic ones quotients F'_R/F_N of the focal point coordinates (image sided), f_R of the focal length (image sided) and differences of the principal p coordinates $(H_R-H_N)/R$ (object sided) and $(H'_R-H_N)/R$ (image sid are represented graphically as functions of the image space poten and U'. The gap between the cylinders was in all cases 0.8 R (R radius of the cylinders). U being the potential on the object side, and U' on the image side, $\kappa = U/U'$ was varied from 0.1 to 0.966 U' from 0 to 2.000 kV; in the relativistic case a maximal departur of about 20% from the nonrelativistic values was found for the foc length. A ten-lens accelerator of 1.5 MeV overall voltage has bee calculated both ways.

537.

15092 THE THEORY OF THE MOTION OF AN ELECTRON A LINEAR BETATRON.

Ts.I.Gutsunaev and Ya.P.Terletskii.
Zh. tekh. Fiz., Vol. 30, No. 5, 491-6 (May, 1960). In Russian.

Electrons moving in an axially symmetric magnetic field var nonlinearly along the axis (a linear betatron) gain energy. Relati for gain and stability of motion are given, and inadequacies of ear theories pointed out. Much less energy is lost by radiation than i an ordinary betatron. A.E.I.Research Laborato

537.

15093 PATH STABILITY IN CIRCULAR ACCELERATORS. J.Biersack.

Z. angew. Phys., Vol. 12, No. 6, 262-75 (June, 1960). In German.

The field distributions in three types of accelerator, pulsed field/alternating gradient, fixed field/alternating gradient and pul field/constant gradient, are developed. For all three types, the p motion is derived by solving the appropriate Hills differential equ tion, the treatment distinguishing between stable and unstable orb
R.R

537.

15094 EXTRACTION AND ANALYSIS OF THE BEAM OF TH LOUVAIN CYCLOTRON.

A.Gonze, R.Keppenne and P.C.Macq.
Ann. Soc. Sci. Bruxelles I, Vol. 74, No. 2, 140-55 (1960). In Fre

The different stages in the extraction, focusing and analysis the beam from the Louvain cyclotron, which accelerates deuteron and alpha-particles to 12 and 24 MeV respectively, are described. Direct and analysed beams of several microamperes per cm^2 wer obtained. It is proposed to use the first for the production of 28 M neutrons from a tritium target, and the second to study the inelast scattering of 24 MeV alpha-particles.

A.E.I. Research Laborato

537.54

095 STABILITY AND ISOCHRONISM IN CYCLOTRONS WITH STAR-SHAPED MAGNETIC FIELDS. F.Fer.

ys. Radium, Vol. 20, Suppl. No. 4, 5A-17A (April, 1959).
ench.

The relation between a magnetic field and the family of equilib- trajectories of a particle in this field results from two factors: ely geometric one (the form of the curves), and a kinematic r (the distribution of the velocities on the successive curves). possible to define, for every trajectory, two scalar parameters: pending only on the geometric form, and k on the distribution locities. The double stability is characterized by both the alities: $0 < k < k_2$, from which the equation of compatibility een stability and isochronism proceeds directly. This last tion introduces a compatibility factor γ which is also able to ribe the strong focusing. k_2 and γ are given by cyclic integrals very simple form, which permit the effect of physical data (field , number of sectors) to be examined qualitatively and quantita- y.

537.54 : 621.384.611

5096 VARIABLE ENERGY SPIRAL RIDGE CYCLOTRON. J.S.Allen, S.Chatterjee, L.E.Ernest and A.I.Yavin.

sci. Instrum., Vol. 31, No. 8, 813-22 (Aug., 1960).

A spiral ridge cyclotron which can accelerate protons from to 15 MeV, deuterons from 7 to 14 MeV, $(He^3)^{++}$ from 11 to 37 MeV, α-particles from 15 to 27 MeV is described. The required mag- c field is obtained from four spiral shims and five correction s placed on each of the pole faces of the magnet. The spiral ns produce a maximum r.m.s. flutter of 0.07 which provides icient vertical focusing beyond a radial distance 6 in. from the re of the cyclotron. The two innermost correction coils pro- magnetic focusing up to 6 in. and the three outer coils build up isochronous field. Focusing effects of slits, placed on the dee dummy dee in the path of the particles for the first four revolu- s, are demonstrated. The machine can deliver 1 mA of proton n at the extraction radius, 18.5 in.

537.54 : 621.384.612

5097 PHASE OSCILLATIONS IN HIGH CURRENT SYNCHROTRONS. I.G.Henry.

ppl. Phys., Vol. 31, No. 8, 1338-42 (Aug., 1960).

The theory of phase oscillations in the synchrotron, first given ohm and Foldy [Abstr. 469B of 1947; Phys. Rev., Vol. 70, 249-58 t. 1 and 15, 1946)], is extended to cover the case where the ampli- of the accelerating voltage is not constant and where the accel- ed bunch is itself sufficiently large to produce an appreciable of the accelerating voltage. It is found that the phase oscillation ore stable when the driving frequency is less than the natural uency of the accelerating electrode system, and that the anode acteristic of the driving amplifier has a negligible effect on the e stability.

537.54

15098 EVALUATION OF THE CHANGE OF AMPLITUDE OF VERTICAL BETATRON OSCILLATIONS IN HIGH- RRENT ACCELERATORS WITH THE HELP OF A REGENER- VE DEFLECTOR. Yu.Ya.Lembra.

tekh. Fiz., Vol. 30, No. 4, 405-12 (April, 1960). In Russian.

Accelerators are considered in which particles move in a iodic magnetic field. The amplitude of vertical oscillations is mined theoretically. Different arbitrary functions for the vertical eleration are assumed in the region of a regenerative magnetic ector and over the rest of the particle orbit. The final value the mean square of the change of amplitude shows an additional n added to that given by Le Couteur's theory (Abstr. 2754 of 2). J.H.Fremlin

537.54

5099 PRELIMINARY RESULTS OF THE DETERMINATION OF THE BREMSSTRAHLUNG SPECTRUM OF THE ASCATI ELECTRON SYNCHROTRON.

iambrini, A.S.Figuera, A.Serra and B.Rispoli.

vo Cimento, Vol. 15, No. 3, 500-3 (Feb. 1, 1960). In Italian.

Presents the experimental details and some preliminary results he analysis of the synchrotron bremsstrahlung beam. Some ors affecting the shape of the spectrum are discussed.

S.J.St-Lorant

537.54

15100 OBSERVATION OF QUANTUM EFFECTS IN AN ELECTRON SYNCHROTRON. M.Sands.

Nuovo Cimento, Vol. 15, No. 4, 599-605 (Feb. 16, 1960).

The rate of loss from synchronism of electrons in a synchrotron was measured for various accelerating voltages and for electron energies from 800 to 1200 MeV. The results agree with a computation of the loss expected from the quantum excitation of phase oscillations.

537.54

15101 THE MAGNETIC DEFLECTOR OF THE BUENOS AIRES 180-cm SYNCHROCYCLOTRON BEAM.

J.Rosenblatt and R.J.Slobodrian.

Rev. sci. Instrum., Vol. 31, No. 8, 863-8 (Aug., 1960).

The magnetic deflector system of the Buenos Aires 180 cm synchrocyclotron beam consists of a regenator and a critical magnetic channel [Nuclear Instrum. and Methods, Vol. 2, No. 1, 9 (Jan., 1958)] The channel was built starting on the maximum of the radial oscillation and following a trajectory given by $\rho = 83.5 + 10\alpha^{11/4}$ (in cm), where (ρ, α) are polar coordinates with the origin at the centre of the machine and α is measured from the maximum of the radial oscillation. Alternating gradient magnetic fields were used in order to keep the beam parallel up to the magnetic quadrupoles. Thus the vertical divergence of the beam is vanishingly small and the radial divergence is 1/200. With the complete assembly in place 20% of the circulating beam is thrown by the regenerator into the magnetic channel, and its transmission is 10%. The over-all extraction efficiency is therefore 20%.

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538

15102 THE MEASUREMENT OF A MAGNETIC FIELD BY THE USE OF A CAESIUM FREQUENCY STANDARD.

G.Giachino.

Atti. Accad. Sci. Torino I, Vol. 94, No. 3a, 386-405 (1959-60). In Italian.

Describes an instrument based on known principles but includes experimentally-obtained equi-field curves showing the kind of results obtained by this method. V.G.Welsby

538

15103 PROTON VECTOR MAGNETOMETER. L.Hurwitz and J.H.Nelson.

J. geophys. Res., Vol. 65, No. 6, 1759-65 (June, 1960).

Z and H, as well as F, have been measured at the Fredericksburg Magnetic Observatory with a proton vector magnetometer, combining a proton-precession intensity magnetometer and a Helmholtz coil system mounted on a horizontal circle. Formulae for the effect of various instrumental adjustments are given without proof; the only critical adjustment is the level of the horizontal circle (magnetometer base). The internal consistency of the observed values Z_P, F_P, and H_P is indicated by the smallness of computed values $H_P - (F_P^2 - Z_P^2)^{1/2}$; these values are less than 3 γ in magnitude and have a mean of 0.4 γ. Preliminary results of comparisons with the observatory sine galvanometer and earth inductor are:
PVM – SG (measurements of H) = 2.7 γ; PVM – EI (measurements of dip) = 1''. The source of the H difference is now being investigated.

538 : 550.3

THE VECTOR FIELD PROTON MAGNETOMETER FOR I.G.Y. SATELLITE GROUND STATIONS. See Abstr. 14161

538

15104 NUCLEAR MAGNETIC RESONANCE APPARATUS FOR THE RELATIVE MEASUREMENT OF MAGNETIC FIELDS. S.Vrščaj.

"J.Stefan" Inst. Rep., Vol. 3, 95-7 (Oct., 1956). In German.

538

15105 INDUCTION APPARATUS FOR THE CONTINUOUS MEASUREMENT OF MAGNETIC SUSCEPTIBILITY.

W.A.Norder.

Rev. sci. Instrum., Vol. 31, No. 8, 849-51 (Aug., 1960).

An induction apparatus is described for measurement of the paramagnetic susceptibility of metals during exposure to gases, specifically hydrogen. Provision is made for heating to 5000°C and for removal or addition of gas during measurement. The device may be adapted for use at low temperatures.

538 : 621.317.44

15106 **A STUDY OF MAGNETIC FOCUSING SYSTEMS.** M.Arnaud and O.Cahen.

Rev. tech. C.F.T.H., No. 32, 41-58 (Feb., 1960). In French.

The first part describes a "recording turbine magnetometer", in which compressed air drives a rotating copper vane, the magnetically induced current in which induces current in a fixed coil connected to an amplifier and recorder. Magnetometer probes of 6 and 9 mm size, with vane speeds of 400 to 500 rev/sec, measure fields from 0.5 to 3000 Oe with attainable accuracy of 0.5%. The second part deals with, and gives examples of, use of the magnetometer in association with an electrolytic tank, for designing and correcting magnetic circuits for the production of fields such as those used in the focusing of O-tubes. B.Meltzer

538.1 : 621.318.23

15107 **PERMANENT MAGNETS OBTAINED BY DRAWING COMPACTS OF PARALLEL IRON WIRES.** F.P.Levi.

J. appl. Phys., Vol. 31, No. 8, 1469-71 (Aug., 1960).

The method consists of drawing a compact containing parallel iron wires spaced by a copper alloy matrix until the iron wires become extremely small. Intrinsic coercive forces of 400 Oe have been measured in samples drawn from compacts in which the initial spacing between the iron wires corresponded to an iron packing fraction p of about 0.45. Annealing of cold drawn samples generally increased both the coercive force and the squareness of the demagnetizing curve.

538.1 : 621.318.381

15108 **TEMPERATURE-CONTROLLED PERMANENT MAGNET FOR HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE.** B.A.Evans and R.E.Richards.

J. sci. Instrum., Vol. 37, No. 9, 353-5 (Sept., 1960).

The design and construction of a large temperature-controlled permanent magnet is described and the considerations given towards obtaining a high degree of field uniformity. Using current shims and a spinning sample, a resolving power and stability of a few parts in 10^8 may be obtained at any time and, with care, 1 part in 10^8 can be achieved.

538.1 : 621.316.721

15109 **A STABLE CURRENT SOURCE FOR A LABORATORY ELECTROMAGNET.** P.Pilod.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4319-21 (June 27, 1960). In French.

The source consists of a dynamo and four transistor stages. Temperature compensation is arranged by the use of a selected Zener diode. More than 4 kW is available with a measured stability of 2 in 10 000 over a half-hour period. C.A.Hogarth

538.1

15110 **A COOLED, METALLIC CONDUCTOR CARRYING CURRENT OF HIGH DENSITY AND USED ACCORDING TO THE "PRINZIP DES LEITERERSATZES" FOR THE PRODUCTION OF STRONG MAGNETIC FIELDS.** P.Klaudy.

Acta phys. Austriaca, Vol. 13, No. 2-3, 274-92 (1960). In German.

The limitations to the production of high magnetic field strengths and the temperature distribution in air-cooled and internally water-cooled magnet coil conductors carrying high currents are discussed in considerable detail. It is shown that for good electrical conductors the limiting factors are the thermal conductivity and the thermomechanical properties of the conducting material, but especially the film coefficient between the coolant and the conductor. By the use of the method, referred to as the "Prinzip des Leiterersatzes", in which the portion of the conductor carrying the high current is replaced, continuously and at high speed, by other previously cooled sections, current densities of the order of $10^9 \mathrm{A\,m^{-2}}$ (much higher than those obtainable with internally water-cooled conductors) can be attained. A practical arrangement utilizing the method is described, and formulae for the field strengths obtainable in the two cases are derived and compared. S.Weintroub

538.1

15111 **EFFECT OF LONG-RANGE CORRELATIONS ON FREE ELECTRON DIAMAGNETISM.**

B.Donovan, H.Kanazawa and N.H.March.

Progr. theor. Phys., Vol. 17, No. 6, 813-14 (June, 1957).

An attempt is made to assess the relation between the earlier treatment by Donovan and March (Abstr. 1461 of 1954), based on tl use of the proper dispersion relation, and Kanazawa's more recen treatment (Abstr. 8890 of 1956; 6026 of 1958), using the collective description of Bohm and Pines. The numerical agreement is not completely satisfactory, but it is pointed out that the second metho neglects exchange, and that the inclusion in it of exchange and correlation effects is likely to bring its results nearer to those of the first method. L.Pincher

538.2 : 537

THE PERMITTIVITY AND PERMEABILITY TENSORS OF A MEDIUM. See Abstr. 14946

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538

15112 **SCHRÖDINGER EQUATION IN MULTIPLY CONNECTE SPACES AND PHASE OPTICS.** H.Wegener.

Z. Phys., Vol. 159, No. 3, 243-7 (1960). In German.

The magnetic vector potential $\vec{A}$ in a field free space R_0 canno be removed by gauge transformations in general, if R_0 is multiply connected. Aharonov and Bohm (Abstr. 12997 of 1959) have notice recently that $\vec{A}$ therefore should have more physical meaning than only to give the magnetic field by differentiation. They could show that $\vec{A}$ in R_0 may influence the phase of Schrödinger's ψ-function in an observable manner. The author points out that this influence can be expressed in a simple, general form: "A closed magnetic field line operates upon ψ like a $e\Phi/\hbar$-phase-shifter placed on any area bounded by the field line". Surfaces like phase shifters are familiar in phase optics. There exists a narrow relationship betwe electron scattering at magnetic fields and some special problems phase optics. An electron phase contrast microscope is discussed

538

15113 **THE STABILIZATION OF ELECTRICALLY CHARGED PARTICLES IN ALTERNATING FIELDS.** H.Straubel.

Acta phys. Austriaca, Vol. 13, No. 2-3, 265-73 (1960). In German.

Three thin cylinder rings were arranged on a vertical axis. One of the outer ones was positive and the other negative, and an a.c voltage was applied to the middle one. The equation of motion a charged particle in the middle of the aperture of the middle ring obeys a Mathieu equation. When viscous damping was present, there was a stability region such that, for suitable ranges of e/m and the amplitude of the a.c. field, a particle could be stably at res For voltages exceeding the stability limit, or when e/m was altere instability set in sharply. The arrangement could be used for a measurement of the e/m ratio or for studies of evaporation of oil drops, etc. The particle was illuminated and the scattered light observed by means of a photomultiplier. The photomultiplier curr was proportional to the square of the particle radius. The apparat could thus be calibrated for particle size. Absolute measurement of the particle mass was not possible. H.Mot

538.

15114 **THE RELATIVISTIC MOTION OF A CHARGED PARTIC IN AN INHOMOGENEOUS ELECTROMAGNETIC FIELD** P.O.Vandervoort.

Ann. Phys. (New York), Vol. 10, No. 3, 401-53 (July, 1960).

The guiding centre approximation for the relativistic motion of a charged particle in a nonuniform electromagnetic field is treated by a method which exhibits the nonconstancy of the adiabatic invariant. The position of the particle is expressed in terms of variables which represent the gyration and the motion of the guidin centre, respectively; the equations which govern these variables ar derived. The equation for the gyration is solved by an iteration method, and the solution is carried to the second approximation. I special cases, this solution suffices to determine the change in the adiabatic invariant. The adiabatic invariant is interpreted as the relativistic analogue of the magnetic flux by the Larmor orbit. In eac approximation, the equation for the motion of the guiding centre is derived. An integral of this equation expresses the invariance of the square of the four-velocity. A systematic method is described for solving the equation for the motion of the guiding centre in the case that the electric and magnetic fields are almost mutually perpendicular.

538.3

15115 THE CANONICAL THEORY OF MOTION OF CHARGED PARTICLES IN EXTERNAL ELECTRO-GNETIC FIELDS.

T.Taniuti.

vo Cimento, Vol. 16, No. 3, 572-5 (May 1, 1960).

A canonical transformation is employed to show that in the case identical charged particles moving in an electromagnetic field ch is of a certain type and which acts on the particles with forces ge compared with their forces of interaction, the motion may be arated into a drift of the guiding centre and a gyration about it.

P.M.Davidson

538.3 : 575.52

15116 ON THE EJECTION PHENOMENON IN AN ELECTRIC DISCHARGE.

V.N.Zhigulev.

kl. Akad. Nauk. SSSR, Vol. 130, No. 2, 280-3 (Jan. 11, 1960). In ssian.

The theory of an electric discharge in a viscous fluid with ite electrical conductivity is considered. It is shown that an ally symmetric discharge is in principle accompanied by motion the fluid, which tends to eject fluid along the axis of symmetry the direction of decreasing magnetic field. Similarity laws for axially symmetric discharge are obtained, and a method for aining similarity solution of the appropriate equations is given.

O.Penrose

538.3

15117 ON SOME CLASSES OF STATIONARY TWO-DIMENSIONAL SOLUTIONS OF MAGNETOGASDYNAMICS.

ap and E.Hofinger.

ta phys. Austriaca, Vol. 13, No. 2-3, 262-4 (1960). In German.

It is pointed out that the equations describing steady irrotational w of a perfectly conducting ideal gas can be satisfied by taking = const × v everywhere. A result concerning the stability of h a flow is quoted. It is also shown how to simplify the equations ng a magnetic stream function when there is plane or cylindrical nmetry but $H \neq$ const × v.

O.Penrose

538.3

15118 FLUCTUATIONS OF THE MAGNETIC FIELD AND OF THE CURRENT DENSITY IN TURBULENT FLOW OF SLIGHTLY CONDUCTING FLUID.

G.S.Golitsyn.

kl. Akad. Nauk SSSR, Vol. 132, No. 2, 315-18 (May 11, 1960). Russian.

The differential equation for the fluctuation component of the gnetic field in a slightly conducting fluid (e.g. the ionosphere, an ean) was found to be analogous to the heat conduction (diffusion) uation. The characteristic parameters of turbulences which ect the magnetic field were estimated. Also, the volume spectra the fluctuating magnetic field intensity and the current vectors re determined. The results were applied to the ionosphere in der to estimate the influence of magnetic storms on turbulences the ionosphere.

J.K.Skwirzynski

538.3

15119 SOME "PROGRESSIVE" PLANE-WAVE MOTIONS OF A GAS IN MAGNETOHYDRODYNAMICS.

O.A.Berezin.

kl. Akad. Nauk SSSR, Vol. 133, No. 2, 296-8 (July 11, 1960). Russian.

The solutions of the magnetohydrodynamic equation for motion an ideal gas (high electric and low thermal conductivity; low scosity) in a transverse magnetic field are quoted and discussed om the point of view of magnetic-field amplification in a hydro-agnetic dynamo.

J.K.Skwirzynski

538.3

15120 NON-STATIONARY FLOW OF A CONDUCTING FLUID IN A PLANE TUBE IN THE PRESENCE OF A TRANS-ERSE MAGNETIC FIELD.

I.B.Chekmarev.

h. tekh. Fiz., Vol. 30, No. 3, 338-44 (March, 1960). In Russian.

A viscous incompressible conducting fluid between two infinitely ick solid walls is initially at rest in a uniform magnetic field per-endicular to the walls. A uniform pressure gradient is suddenly oplied. The Laplace transforms of the velocity and of the electric nd magnetic fields are calculated. For perfectly conducting walls nly, the inversion of these transforms performed; in contrast with e non-magnetic case, damped oscillations can appear in some rms of the solution.

O.Penrose

538.3

15121 AN INVESTIGATION OF THE UNSTEADY FLOW OF A CONDUCTING FLUID IN A PLANE CHANNEL WITH MOVING BOUNDARIES.

Ya.S.Uflyanol and I.B.Chekmarev.

Zh. tekh. Fiz., Vol. 30, No. 5, 465-71 (May, 1960). In Russian.

A viscous incompressible conducting fluid between parallel plane-faced imperfectly conducting walls is considered. The walls are at rest for $t < 0$ and move arbitrarily for $t > 0$. The displacement current in the walls is allowed for. The equations are formally solved by the Laplace transformation. If the wall velocity is constant, it is shown that the spectrum of the fluid velocity includes both a discrete and a continuous part; accordingly the deviation of the fluid velocity from its final value behaves asymptotically as $t^{-1/2}$, not exponentially as in the non-magnetic case.

O.Penrose

538.3

15122 SOME CASES OF NON-STATIONARY FLOW OF A CONDUCTING FLUID IN AN ANNULAR TUBE.

Ya.S.Uflyand.

Zh. tekh. Fiz., Vol. 30, No. 7, 799-802 (July, 1960). In Russian.

The magnetohydrodynamic equations for the velocity of fluid and for the induced magnetic field (under transient conditions) are set up. The equations can be reduced to a single quadrature (Bessel function integrals) for the case when the viscous and the magnetic Reynolds numbers of the fluid are equal, the outer cylinder of the tube is very large, and the inner tube is perfectly conducting. A still simpler case occurs when the fluid is ideal (non-viscous).

J.K.Skwirzynski

538.3 : 536.2

15123 STEADY AND TRANSIENT FREE CONVECTION OF AN ELECTRICALLY CONDUCTING FLUID FROM A VERTICAL PLATE IN THE PRESENCE OF A MAGNETIC FIELD.

A.S.Gupta.

Appl. sci. Res. A, Vol. 9, No. 5, 319-33 (1960).

An analysis is made for the laminar free convection and heat transfer of a viscous electrically conducting fluid from a hot vertical plate in the case when the induced field is negligible compared with the imposed magnetic field. It is found that similar solutions for velocity and temperature exist when the imposed magnetic field (acting perpendicular to the plate) varies inversely as the fourth root of the distance from the lowest end of the plate. Explicit expressions for velocity, temperature, boundary layer thickness and Nusselt number are obtained and the effect of a magnetic field on them is studied. It is found that the effect of the magnetic field is to decrease the rate of heat transfer from the wall. The method of characteristics is employed to obtain solutions of the time-dependent hydromagnetic free convection equations (hyperbolic) of momentum and energy put into integral form. The results yield the time required for the steady flow to be established, and the effect of the magnetic field on this time is studied.

538.3

15124 FLOW OF A CONDUCTING GAS ROUND A CURRENT-CARRYING PLATE.

A.P.Kazantsev.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 318-20 (July 11, 1960). In Russian.

Flow of a conducting gas round an inhomogeneous region of the magnetic field, creates a gas-free cavity surrounding that region. A plate of width L is inclined at an angle α to the x-axis, pointing along the direction of gas flow (the system is two-dimensional). The gas-free cavity is of critical shape and dimensions when $L = 2\pi\lambda/\sin\alpha$, where $\lambda = I/c\sqrt{2\pi p_0}$, I is the current in the plate and p_0 is the axial pressure on the plate.

J.K.Skwirzynski

538.3

15125 FLAT PLATE DRAG IN MAGNETOHYDRODYNAMIC FLOW.

H.P.Greenspan.

Phys. of Fluids, Vol. 3, No. 4, 581-7 (July-Aug., 1960).

In sub-Alfvén magnetohydrodynamic flow past a flat plate (the free stream fluid velocity is less than the Alfvén wave speed) the vorticity generated within the fluid is propagated upstream by Alfvén waves and produces a forward disturbance which in form is very similar to the viscous wake. The structure and strength of the wake and precursor are herein examined and compared for large Reynolds numbers and finite conductivity. As the conductivity increases, a larger proportion of the total vorticity is propagated upstream so that the precursor becomes more pronounced and the wake weakens. Explicit formulae for the skin friction and drag coefficient are determined for arbitrary values of the conductivity, and the results clearly exhibit the effects of the interaction of fluid flow and magnetic field.

538.3 : 533.6

BLUNT BODY VISCOUS LAYER WITH AND WITHOUT A MAGNETIC FIELD. See Abstr. 14671

538.3

15126 THE VORTEX EQUATIONS OF MAGNETOHYDRODYNAMICS. H.C.Brinkman.
Physica, Vol. 25, No. 11, 1063-6 (Nov., 1959).

The vortex equations of magnetohydrodynamics are derived. Three vorticities, viz. a material, an electrical and a magnetic vorticity are introduced. In their integral form, i.e. as equations for the material and the electrical circulation, the equations are applied to a rotating plasma in a thermonuclear device.

538.3

15127 INTERACTIONS OF HYDROMAGNETIC WAVES. Y.Kato.
Progr. theor. Phys., Vol. 21, No. 3, 409-20 (March, 1959).

A generalized Rankine—Hugoniot relation for hydromagnetic shock waves propagating perpendicularly to the magnetic field is discussed. The interaction of the shock or rarefaction waves with the contact surface on which the magnetic field has a discontinuity is analysed by a graphical method. The motion of the high temperature part of a plasma surrounded by the strong magnetic field and the electric current is investigated applying the result of the above analysis It is shown that under some initial conditions the contracting motion of the plasma occurs following its expansion.

538.3

15128 WEAK DISCONTINUITIES OF MAGNETOHYDRODYNAMICS. J.Szabó.
Z. Naturforsch., Vol. 15a, No. 5-6, 503-5 (May-June, 1960). In German.

It is shown that weak discontinuity surfaces in ideal plasmas move with the velocity of small disturbances. It is also proved that the progressing surfaces of weak discontinuity are identical with the characteristics of the system of equations of magnetohydrodynamics of ideal media. H.Motz

538.3 : 537.56

MAGNETOHYDRODYNAMICS OF A TERNARY PLASMA. See Abstr. 15038

538.3 : 525

15129 DAMPING OF THE SATELLITE WAKE IN THE IONOSPHERE. S.Rand.
Phys. of Fluids, Vol. 3, No. 4, 588-99 (July-Aug., 1960).

Landau damping of the ion plasma oscillations which constitute the wake of a line charge moving supersonically through a low-density plasma is studied. Maxwellian distribution functions in the ambient plasma for both electrons and ions have been assumed. It is found that the damping is critical to the question of whether the electrohydrodynamic wake produced by a satellite in the ionosphere is observable, unless the electron temperature is at least an order of magnitude greater than the ion temperature.

538.3

15130 CURRENT DISTRIBUTION IN THE REGION OF THE LONGITUDINAL AXIS OF THE CHANNEL OF A CONSTANT-CURRENT PUMP. Yu.Birzvalks.
Latv. PSR Zinat. Akad. Vestis, No. 2(151), 63-72 (1960). In Russian.

The flow of liquid along the axis of an electromagnetic liquid metal pump is calculated. Optimum flow demands certain relative dispositions of the electrodes and magnetic pole pieces. It is shown that these are not always fulfilled in practice, and improvements are suggested. A.E.I. Research Laboratory

538.3

15131 ENGINEERING ASPECTS OF MAGNETOHYDRODYNAMICS. G.W.Sutton.
Phys. Today, Vol. 13, No. 6, 36-9 (June, 1960).

A report on the Symposium on the Engineering Aspects of Magnetohydrodynamics sponsored by the Basic Sciences Committee of the American Institute of Electrical Engineers. The programme consisted of four sessions; communications and diagnostics, power conversion, fusion, and flight applications.

538.3

15132 THE ISOTHERMAL SHOCK IN MAGNETOHYDRODYNAMICS. V.I.Iseplyaev.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 255-6 (Jan., 1960). In Russian.

It is pointed out that if all irreversible effects except heat conduction are neglected in a hydromagnetic shock then a one-param family of isothermal shocks is possible, and in shocks weaker tha these isothermal shocks the hydrodynamic quantities vary smooth Formulae and a graph illustrating the situation are given, but no derivations. O.Penr

53

15133 ON CERTAIN PROPERTIES OF HYDROMAGNETIC SHOCKS. W.B.Ericson and J.Bazer.
Phys. of Fluids, Vol. 3, No. 4, 631-40 (July-Aug , 1960).

Proofs of four basic properties of the stationary, planar non-relativistic hydromagnetic shocks are presented These properti are: (P_1) the specific entropy behind a hydromagnetic shock exceed that ahead, if and only if, the shock is compressive; (P_2) the specific entropy behind a compressive shock varies in the same sense as the mass flux; (P_3) in the region behind (compressive) fast sho the fast disturbance speed is greater than the normally directed fluid velocity relative to the shock; (P_4) in the region behind (compressive) slow shocks, the slow disturbance speed may be less tha equal to, or greater than the normally directed fluid velocity relative to the shock. The equality holds when the specific entrop and the mass flux assume their maximum values. In these statements the state in front is assumed fixed and attention is focused on the variation of the state behind with an appropriate shock stre parameter. The proof of P_1 is designed especially to cover the ca of the slow shock where the dependence of the state behind on the "natural" shock-strength parameters is nonmonotonic. The proof of P_3 and P_4 require the medium to be a polytropic ideal gas; however, a less stringent assumption suffices for P_1 and P_2.

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56 : 621.3

15134 ELECTROMAGNETIC WAVES. V.Twersky.
Phys. Today, Vol. 13, No. 7, 30-6 (July, 1960).

Report of a conference held in Toronto, June 1959 under the joint title, "International Symposium on Electromagnetic Wave Theory". It was sponsored jointly by the Union Radio Scientifique Internationale and the University of Toronto. There were 65 pape dealing generally with scattering, surface waves and aerials.

538.56 : 535.8 : 621.396.969.

COMBINED OPTICAL—MICROWAVE SYSTEM CONSIDERATIONS. See Abstr. 14812

538.56 : 621.3

15135 NEW DEVELOPMENTS IN MICROWAVE PHYSICS. H.Severin.
Naturwissenschaften, Vol. 47, No. 10, 217-21 (1960). In German.

Historical survey of the developments from Maxwell to the present day. In particular, an account is given of advances made in the ferromagnetic materials, their composition and characteristics (illustrated freely by graphs) and their application to micr wave devices. The principles of operation of a parametric amplifiers are explained. 22 references. Z.F.Voyne

538.56 : 539.17 : 551

15136 ELECTROMAGNETIC SIGNALS FROM NUCLEAR EXPLOSIONS IN OUTER SPACE.
M.H.Johnson and B.A.Lippmann.
Phys. Rev., Vol. 119, No. 3, 827-8 (Aug. 1, 1960).

The thermal X-rays produced by a nuclear burst in outer spac cause polarization currents in the medium which, if distributed anisotropically, will emit electromagnetic radiation. Roughly, a burst of thermal X-rays, equivalent in energy to 1 ton of high explosive, produces a detectable 10 Mc/s signal at a range of 1 km. Since only the ratio of X-ray energy to range enters into the streng of the radiated signal, other ranges follow by adjusting the X-ray energy proportionately. This works up to ~3 × 10^3 km; beyond this range, dispersive effects begin to reduce the signal received. The power in the electromagnetic signal varies as the square of the electron density, so this effect may provide a sensitive measure of the density of electrons in outer space.

538.56 : 621.373.422

5137 MILLIMETRE WAVES FROM MERCURY ARC HARMONIC GENERATOR. K.D.Froome.

ure (London), Vol. 186, 959 (June 18, 1960).

Harmonic generation from a small high-pressure mercury arc been extended to using a 1 W 8 mm waveband klystron as the amental. The sixth harmonic (1.43 mm wavelength) was detected a Golay cell, giving a power of about 10^{-8} W. The fourth monic, was 15 dB stronger. Improvements of about 100 times ıld be possible if a more efficient matching arrangement can be sed. D.Walsh

538.56 : 621.375.9

15138 AN INTRODUCTION TO THE THEORY OF SOLID-STATE MASERS. P.N.Butcher.

oc. Instn Elect. Engrs, Paper 3220 E, publ. Feb., 1960. (Vol. 107B, -51, 352-3).

Republication, with discussion, of the paper already abstracted Abstr. 3848 of 1960.

538.56 : 621.375.9

15139 PARAMETRIC AMPLIFIER THEORY FOR PLASMAS AND ELECTRON BEAMS. G.S.Kino.

Appl. Phys., Vol. 31, No. 8, 1449-58 (Aug., 1960).

A theory is given for a new type of parametric amplifier which es a gas-discharge plasma as a nonlinear propagating medium. is theory is based on a zero-temperature plasma assumption. e nonlinear coupling between travelling waves passing through the sma is determined by taking second-order terms in the velocity o account. A simplified normal mode theory is used to describe e effect on the propagation constants of the individual modes due coupling between them. The theory is carried out in detail for a sma in an infinite magnetic field and for a plasma in a zero gnetic field. The final propagation equation for the travelling ves is found in terms of the fields in the plasma of a small-signal mping wave, signal wave, and idler wave. The theory is extended cover the case of beam-type parametric amplifiers. It is shown t the theory is applicable both to beam-type amplifiers which e space-charge waves for all three modes of propagation or to ves which are partially those of a circuit and of the beam itself. e results obtained are in agreement with the theory of Louisell d Quate for the principal waves of a space-charge wave parametric plifier.

538.56 : 621.318.132

15140 THE TEMPERATURE AND FREQUENCY DEPENDENCE OF THE FARADAY EFFECT FOR MILLIMETRE AVELENGTHS. D.I.Mash.

. tekh. Fiz., Vol. 28, No. 12, 2713-15 (Dec., 1958). In Russian. glish translation in: Soviet Physics—Technical Physics (New rk), Vol. 3, No. 12, 2483-5 (Dec., 1958).

The advantages of Faraday rotation devices as microwave olators and modulators are discussed. Measurements of e frequency and temperature dependence of Faraday rotation and sertion loss made on four kinds of ferrites — NTs-500, B-1000, -600 (the compositions of which are not mentioned) and NiAl — er the temperature range from room temperature to 180°C and the 8 mm wavelength region are reported and discussed. The paratus used is described briefly. S.A.Ahern

538.56

15141 ON REFLECTION OF ELECTROMAGNETIC WAVES FROM A MOVING SURFACE. V.I.Kurilko.

. tekh.Fiz., Vol. 30, No. 5, 504-7 (May, 1960). In Russian.

Gives a general discussion of the frequency and amplitude anges of a plane electromagnetic wave propagated between two rallel, infinite and perfectly conducting planes which move wards each other with constant velocity. J.K.Skwirzynski

538.56 : 535.42

15142 DIFFRACTION THEORY IN THE k-REPRESENTATION. H.M.Nussenzveig.

. Acad. Brasil. Cienc., Vol. 31, No. 4, 515-21 (1959).

A monochromatic wave-function defined in a half-space may be presented by a superposition of travelling waves and evanescent aves (k-representation). General rules for evaluating Fraunhofer d Fresnel diffraction patterns in this representation are derived, applying the Principle of Stationary Phase. It is shown that the assical patterns depend only on a very small spectral region. his leads to a qualitative explanation of the success of classical ffraction theory.

538.56 : 534.2

15143 GENERALIZATION OF THE CONDITION AT AN EDGE. P.Poincelot.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4316-18 (June 27, 1960). In French.

The condition established in a previous paper (Abstr. 1204 of 1960) concerning the solution of diffraction or propagation problems in the presence of sharp boundaries (e.g. the case of a sheet of infinitesimal thickness) is extended to the case of a solid of more general form. P.M.Davidson

538.56 : 534.26

15144 ON THE DIFFRACTION OF AN ARBITRARY PULSE BY A WEDGE OR A CONE. Lu Ting.

Quart. appl. Math., Vol. 18, No. 1, 89-92 (April, 1960).

By virtue of Green's theorem, it is shown that for the diffraction of an arbitrary two-dimensional incident pulse by a wedge of angle μ, the ratio of the resultant velocity potential to the corresponding value of the incident pulse at the corner of the wedge at any instant is equal to $2\pi/(2\pi - \mu)$; and that for the diffraction of a three-dimensional pulse by a cone of solid angle ω, the ratio at the vertex of the cone is equal to $4\pi/(4\pi - \omega)$.

538.56

15145 ARBITRARY INCIDENCE OF A PLANE ELECTROMAGNETIC WAVE ON A CONDUCTING DISK.

V.N.Kuritsȳn.

Zh. tekh. Fiz., Vol. 30, No. 7, 790-8 (July, 1960). In Russian.

Considers diffraction of an arbitrarily polarized plane wave on a disk. Expressions are obtained for the current density induced in the disk and for the scattering radiation pattern. The validity of these formulae is limited to small values of the parameter ka ($k = \omega/c$ = free-space wave-number; a = radius of the disk). The expressions are correct up to the order of $(ka)^4$ for the current density and up to the order of $(ka)^7$ for the radiation pattern. J.K.Skwirzynski

538.56

15146 DIFFRACTION OF A PLANE ELECTROMAGNETIC WAVE BY CYLINDERS WITH ANISOTROPIC CONDUCTIVITY. R.E.Kelly and A.Russek.

Nuovo Cimento, Vol. 16, No. 4, 593-610 (May 16, 1960).

The diffraction of a plane electromagnetic wave at an arbitrary angle of incidence on isotropic and hollow anisotropically conducting cylinders of infinite length is investigated. The anisotropically conducting cylinders considered are (a) a cylinder which conducts in the axial direction only and (b) a cylinder which conducts in the θ-direction only (such as a tightly wound helix). The diffracted fields are determined by meeting the appropriate boundary conditions on the cylindrical surfaces. Expressions are also given for the induced surface currents and the cross-sections; plots of the latter and of the angular distribution of diffracted energy are presented. A discussion of the physical mechanism whereby anisotropic conductivity effects differ from those of isotropic conductivity is also included. It is found that the axially conducting cylinder is transparent to an incident TE wave whereas the TM polarization results in a field identical to that of an isotropic cylinder. The θ-conducting cylinders produce diffracted fields which do not preserve the polarization of the incident wave. For increasing ratio of radius to wavelength, the cross-sections increase to a point at which they begin to oscillate and finally approach constant values.

538.56 : 621.372.8

15147 THEORETICAL AND EXPERIMENTAL RESULTS CONCERNING LOADED WAVEGUIDES AND PARTIALLY COAXIAL CAVITIES. R.Combe and M.Feix.

Nuovo Cimento, Vol. 15, No. 5, 760-73 (March 1, 1960). In French.

Gives a method of resolving systems of equations governing the problem of the dispersion relation in a disk-loaded circular waveguide and the problem of the eigenvalue frequency in hybrid cavities used as klystron resonators and wavemeters. By Fourier analysis of the field components up to the sixth order, very good agreement between theoretical and experimental results is obtained.

538.56 : 621.372.851.2

15148 HALF-ROUND INDUCTIVE OBSTACLES IN RECTANGULAR WAVEGUIDE. D.M.Kerns.

J. Res. Nat. Bur. Stand., Vol. 64 B, No. 2, 113-30 (April-June, 1960).

Formulae are derived for the accurate calculation of the lowest-mode, lumped-element representation of perfectly conducting half-round inductive obstacles in rectangular waveguide. These obstacles consist of either one or two opposed semicircular cylindrical indentations extending across the narrow sides of the waveguide. They seem especially suitable for use as precise calculable standards of reflection or impedance in waveguide. Schwinger's integral equation approach is used to obtain stationary expressions for the desired parameters as functionals of the surface currents on the obstacles. Upper bounds are obtained for one of the two parameters. Explicit formulae are derived for the values of the parameters under the assumption of n-term Fourier sine-series expansions for the obstacle currents. Rapid convergence is indicated by numerical evaluations for n = 1, 2, and 3. In the process of obtaining expressions suitable for numerical calculation, an expansion (believed to be new) of the Green's function of the problem is obtained and the sums of certain infinite series of Bessel's functions occurring in this expansion are expressed in terms of definite integrals. A brief numerical table of these sums, sufficient for the evaluation of the n = 1 approximation, is included.

538.56 : 621.372.829

15149 ELECTROMAGNETIC WAVES IN A SPIRAL GUIDE FILLED WITH AN ANISOTROPIC DIELECTRIC.

V.P.Shestopalov, V.A.Slyusarskii, S.D.Andrenko and Ė.I.Chernyakov.
Zh. tekh. Fiz., Vol. 30, No. 6, 644-52 (June, 1960). In Russian.

Gives a derivation and discussion of the dispersion equation and the distribution of power flow in a spiral guide filled with an anisotropic dielectric. Two cases are considered: (1) the spiral is wound on a cylindrical anisotropic dielectric and placed in a tube made of an isotropic dielectric, (2) the cylindrical anisotropic dielectric is placed in a tube made of an isotropic dielectric on which the spiral is wound. The experimental results quoted confirm the theoretical conclusions. J.K.Skwirzynski

538.56 : 621.396.677.883.2

15150 THE UNIQUENESS OF SOLUTION OF THE INTEGRAL EQUATIONS IN AERIAL THEORY (OF THE FIRST KIND).

N.N.Govorun.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 91-4 (May 1, 1960). In Russian.

The method of solution of the integral equation for cylindrical aerials, developed previously (Abstr. 13512 of 1959) is considered again for a perfectly conducting aerial. The equations for azimuthal and for meridional currents and fields are developed and it is shown that the method provides unique solutions. J.K.Skwirzynski

538.56 : 534.23

ELECTROMAGNETIC STRIP ARRAYS: SIGNAL/NOISE PERFORMANCE. See Abstr. 14735

538.56

15151 INVESTIGATIONS OF HELIX—ANISOTROPIC DIELECTRIC AND HELIX—RIBBED STRUCTURE SLOW-WAVE SYSTEMS. II.

V.P.Shestopalov, V.A.Slyusarskii and K.P.Yatsuk.
Zh. tekh. Fiz., Vol. 30, No. 7, 835-9 (July, 1960). In Russian.

For Pt I, see Abstr. 11055 of 1960. The perturbation method was used to measure the dispersion and the coupling impedance of a helix with an anisotropic dielectric (the helix was placed in a periodic dielectric medium), of a helix with a ribbed structure and of a helix with a periodic step structure. The coupling impedance was also measured with the aid of an electron beam. The experimental results were compared with the authors' theory (Pt I). J.K.Skwirzynski

538.56 : 621.396.67

15152 RADIATION CHARACTERISTICS OF AN IDEALLY CONDUCTING SPHERE PLACED IN A NON-HOMOGENEOUS MEDIUM.

Yu.S.Sayasov.
Zh. tekh. Fiz., Vol. 29, No. 12, 1486-9 (Dec., 1959). In Russian.

A generalized case of the study of the radiation characteristics of conducting bodies is considered in which the surrounding medium is non-homogeneous having a complex permittivity and working into an absorbing load. Z.F.Voyner

538.56 : 530.14

RADIATION FIELD OF A CAVITY : QUANTUM-MECHANICAL FORMALISM. See Abstr. 14519

538.56

15153 THE RELATIONS BETWEEN THE ELECTRIC AND MAGNETIC FIELDS INDUCED IN A MEDIUM OF VARIABLE CONDUCTIVITY BY A WAVE WITH A VERY LONG PERIOD.

L.Bossy and A.De Vuyst.
Geofis. pura appl., Vol. 44, 119-34 (1959/III). Reprinted in: Contrib. Inst. Roy. Meteorol. Belgique, No. 55. In French.

The ratio between the amplitudes and the phase differences of the oscillations of magnetic and electric fields recorded at ground level appear to be dependent on the variation of the conductivity of the medium with depth, provided that the frequency of the oscillations is in excess of 1 sec. To facilitate the analysis of observati made at Dourbes, several possible distributions of the conducting medium were studied. A composite model consisting of a uniform conducting layer superimposed on a medium with a continuously varying conductivity appears to give the best fit to the experimenta results. S.J.St-Loran

538.5

15154 CARRIER-FREQUENCY DEPENDENCE OF THE BASI TRANSMISSION LOSS IN TROPOSPHERIC FORWARD SCATTER PROPAGATION.

K.A.Norton.
J. geophys. Res., Vol. 65, No. 7, 2029-45 (July, 1960).

A further interpretation is given of certain Lincoln Laborator data obtained in an experiment using scaled aerials as published b Bolgiano [1959]: (1) The significance of these data is considered with regard to the theory of radio propagation through a turbulent atmosphere; (2) A suitable method is described for the measurement of the meteorological parameters entering the theory; (3) A further statistical analysis is applied to these data. On the basis of this analysis, it is concluded that the

$$\{2/\Gamma(\mu)\}(\rho/2)^{\mu}K_{\mu}(\rho)$$

correlation model provides a description of tropospheric turbulenc adequate for the description of these data with μ assigned the fixed value 1, and that the variation of the carrier-frequency dependence of the basic transmission loss from hour to hour arises simply fro a lack of correlation in the hourly median losses on widely separated carrier frequencies rather than from changes of μ in this correlation model.

538.56 : 621.391.812.611.

15155 REFRACTION OF RADIO WAVES AT LOW ANGLES WITHIN VARIOUS AIR MASSES.

B.R.Bean, J.D.Horn and L.P.Riggs.
J. geophys. Res., Vol. 65, No. 4, 1183-7 (April, 1960).

The refractive index structure and bending of radio rays within air masses of nonexponential refractive index height structure is treated in terms of the value expected in an average atmosphere of exponential form. It is demonstrated that refraction differences within air masses arise from departures of refractive index structu from the normal exponential decrease with height. The effect upon radio ray refraction of these departures from the normal exponenti refractive index structure is most pronounced for small initial elevation angles of the radio ray.

538.56 : 621.391.812.624

15156 RADIO PROPAGATION PREDICTION CONSIDERING SCATTERING WAVES ON THE EARTH'S SURFACE.

K.Miya and S.Kanaya.
Rep. Ionosphere Res. Japan, Vol. 8, No. 1, 1-15 (March, 1955).

The control-point method is usually employed in the prediction of the behaviour of radiowave propagation in long distance radio communication channels. For a particular channel, however, this method often gives results disagreeing with observation. With the intention of improving the percentage of successful prediction, this paper deals with the investigation of the method of applying scattering waves on the earth's surface to the prediction of radiowave propagation conditions. A new method called "the control-line method" is proposed. The method of the Ionospheric Predictio Service of Australia, which aims at correcting errors in prediction of propagation conditions is discussed.

538.56

15157 THE PROPAGATION OF ELECTROMAGNETIC WAVES IN IONIZED GASES (WITH SPECIAL REFERENCE TO "WHISTLERS"). I-II.

F.H.Northover.
J. atmos. terrest. Phys., Vol. 17, No. 1-2, 158-69, 170-8 (1959).

Recent studies lend support to the theory that whistling atmospherics are caused by lightning flashes, the electromagnetic energy radiated by these being guided along discrete columnar ionic irregularities which follow approximately the lines of force of the earth's magnetic field. In Pt I the theoretical problems arising are set forth and a general wave theory developed which is first applied to the problem of propagation through homogeneous compound streaming media. In Pt II the simplest case of "standard type" propagation along stationary columns is carefully examined, both for columns h a central ionic surplus and for columns with a central ionic de- iency. Although both types of column, when sufficiently well veloped, can guide electromagnetic energy, it appears that the mer type is a much more likely mechanism for the whistler opagation than the latter.

538.56 : 551.5

15158 THE REFRACTION OF RADIO WAVES BY A SPHERICAL IONIZED LAYER. E.Woyk (Chvojková).

atmos. terrest. Phys., Vol. 16, No. 1-2, 124-35 (Oct., 1959).

A general expression is derived for the refraction of radio waves ssing completely through a spherical ionized layer, using a simple y treatment. A similar formula is derived for the ray-path length. is shown that when certain approximations appropriate to the ter- strial ionosphere are made, neglecting absorption and the effect of e earth's magnetic field, the expression for refraction reduces to simple form which has previously been derived by the author using less general method. The perpetual propagation of radio waves ong two levels in the ionosphere, the condition for which appears in e derivation of the general formula, is briefly discussed. It is own that with slight modifications the refraction formula is also lid for reflection, and an expression giving the distance of the point reflection in the ionosphere from the transmitter on the earth's rface is derived.

538.56

15159 GROUP REFRACTIVE INDEX OF THE IONOSPHERE AT LOW FREQUENCY. Y.S.N.Murty and S.R.Khastgir.

atmos. terrest. Phys., Vol. 17, No. 4, 309-14 (Feb., 1960).

A general expression is obtained for the group refractive dex for low-frequency radio wave propagation in the ionosphere. is shown that, in the limiting case when electron collisional equency is small, this expression for the group refractive index identical with the approximate expression obtained by Gibbons nd Rao (Abstr. 776 of 1960).

538.56

15160 CONDITIONS FOR THE PERSISTENCE OF PURELY LONGITUDINAL OR PURELY TRANSVERSE ROPAGATION. W.C.Hoffman.

. atmos. terrest. Phys., Vol. 18, No. 1, 1-7 (April, 1960).

The conditions for radio waves to propagate through the iono- phere exactly parallel or exactly transverse to the local direction f the centred-dipole-magnetic field are determined. The analysis based on an appropriate form of the Haselgrove equations for ay-tracing in an inhomogeneous anisotropic medium, and the general rms of the refractive indices required for the persistence of urely longitudinal and purely transverse propagation are determined y integration of the Haselgrove equations. The resultant refractive dices do not appear to be appropriate to the ionosphere.

538.56 : 621 391.812.63

15161 ANALYSIS OF IONOSPHERIC PATHS IN LONG-RANGE PROPAGATION. H.J.Albrecht.

dian J. Meteorol. Geophys., Vol. 11, No. 1, 57-63 (Jan., 1960).

Describes new theoretical and technical methods of measuring nd evaluating propagation paths over large distances. A detailed reatment is given of analysis by attenuation measurements and ath diagrams together with essential aspects of ionospheric path ecorders. Reference is made to modernized design and transistor- zation.

538.56

15162 AROUND-THE-WORLD ECHOES OBSERVED ON A TRANSPOLAR TRANSMISSION PATH. J.Ortner.

. geophys. Res., Vol. 64, No. 12, 2464-7 (Dec., 1959).

Fluid Mechanics in Ionosphere, Cornell University, July, 1959 see Abstr. 10417 of 1960). During conditions of nearly perfect eception between December 1958 and March 1959, while observing ulti-path transmissions over a 5200 km path between College, laska and Kiruna, Sweden, received signals were observed on a umber of occasions with delay times indicating that they were in act around-the-world echoes. A table is given showing the times t which the signal was observed together with other relevant data. he field strength observed was often not less than that of a direct ropagated pulse. No similar echoes have been observed at 12 or 4 Mc/s.

G.D.Sims

538.56

15163 V.L.F. PROPAGATION EFFECTS OF A D-REGION LAYER PRODUCED BY COSMIC RAYS. W.F.Moler.

. geophys. Res., Vol. 65, No. 5, 1459-68 (May, 1960).

The single-layered D-region model based only on Lyman α photoionization of nitric oxide is inadequate to explain certain aspects of v.l.f. radio propagation. Empirical evidence indicates the existence of a second and lower D layer which is important for v.l.f. propagation. It is shown that normal cosmic rays produce sufficient ionization for such a layer. The electron-production and -depletion processes effective below 100 km and the latitudinal distribution of cosmic-ray primaries due to the geomagnetic field are discussed. A series of electron-density profiles obtained from photoionization and cosmic-ray ionization processes is compared with the two-layered D-region model deduced from electromagnetic measurements. The calculated phase and amplitude characteristics of v.l.f. signals reflected from the lower cosmic-ray-induced layer during the presunrise hour are in good agreement with those measured.

538.56

15164 V.L.F. REFLECTIONS FROM THE IONOSPHERE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD.

N.F.Barber and D.D.Crombie.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 37-45 (Oct., 1959).

The reflection coefficient is found for waves that are incident on a sharply bounded ionosphere and have their electric vector in the plane of incidence. The earth's magnetic field is assumed to be horizontal and perpendicular to the direction of propagation. Hence the analysis is appropriate for propagation round the magnetic equator. It is found that the reflection coefficient for waves incident from the west is numerically greater than that for waves incident from the east, when the angle of incidence is large.

538.56

15165 POLARIZATION COMPUTATIONS BY MEANS OF THE MULTISLAB APPROXIMATION.

A.J.Ferraro and J.J.Gibbons.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 136-44 (Oct., 1959).

Becker et al. (1951, 1958) discussed a step-discontinuity approximation method for rapidly determining the polarization of low frequency echoes including the effect of collisions and the earth's magnetic field. In the present paper, the results of this method are compared with those of a multislab approximation and it is shown that the step method yields satisfactory results. For two electron density profiles (one near critical coupling and one far removed) the Rydbeck coupling region was subdivided into slabs of uniform media; by matching the fields between adjacent slabs, N - 1 simultaneous techniques were employed to obtain the desired solutions. The rate of convergence was estimated by using an increasing number of slab approximations (as high as 10).

538.56

15166 ON THE MODE OF PROPAGATION IN THE E-LAYER. W.R.Piggott and J.Bhattacharyya.

J. atmos. terrest. Phys., Vol. 17, No. 1-2, 150-7 (1959).

The suggestion of Lépèchinsky and Durant — that f_0E is incorrectly interpreted at stations where the dip exceeds about 60^0 — is critically tested using observed f_0E data. All the tests agree in showing that this hypothesis is wrong, the critical frequency being reduced correctly for stations with dips up to 89^0. The common type of E_S trace extending approximately $f_H/2$ above f_0E, interpreted by Lépèchinsky as a magneto-ionic effect above f_ZE, is shown to be due to sporadic E and not magneto-ionic effect. It follows that the collisional frequency near the maximum of the E-layer is of the order 10^4 sec^{-1} and not 10^6 sec^{-1} as required by Lépèchinsky.

538.56

15167 THE ABSORPTION OF SHORT RADIO WAVES IN THE D-, E- AND F-REGIONS OF THE IONOSPHERE.

J.D.Whitehead.

J. atmos. terrest. Phys., Vol. 16, No. 3-4, 283-90 (Nov., 1959).

The published values of the noon absorption of radio waves of frequencies 2, 2.4, 4 and 4.8 Mc/s measured at Slough from 1947 to 1953 have been analysed. From the absorptions of 2 and 2.4 Mc/s waves, it has been deduced that (a) the electronic collision frequency ν_0 at the height of the maximum electron density in the E-region when the sun's rays are incident vertically on the ionosphere is $(1.9 \pm 0.1) \times 10^4$ per sec; and (b) the normal absorption in the D-region increases with increasing sunspot number, whereas the additional absorption which occurs on certain winter days and arises in the D-region may decrease with increasing sunspot number. The 4 and 4.8 Mc/s waves were reflected from the F-region at noon. The absorption in the F-region is calculated from the known total absorption and the calculated absorption in the D- and E-regions. The collision frequency in the F-region may then be found. At the height of reflection of 4 Mc/s waves (150 to 180 km) it is $(3.6 \pm 0.6) \times 10^3$ per sec, and at the height of reflection of 4.8 Mc/s waves (180 to 200 km) it is $(3.0 \pm 0.6) \times 10^3$ per sec. The significance of these results is discussed.

538.56

15168 THE USE OF FULL-WAVE SOLUTIONS IN THE INTERPRETATION OF IONOSPHERIC ABSORPTION MEASUREMENTS. J.A.Fejer and R.W.Vice.

J. atmos. terrest. Phys., Vol. 16, No. 3-4, 307-17 (Nov., 1959).

A numerical method is developed for solving the equations of ionospheric wave propagation for vertical incidence. The method, which neglects coupling, is used for the calculation of ionospheric absorption. The absorption is first calculated in the usual manner by using the Appleton—Hartree formula and integrating up to the theoretical height of reflection. A "full-wave" correction to this result is then obtained from a step-by-step integration of the wave equation. The thickness of the region, for which this integration has to be carried out, is only a few free space wavelengths, and therefore the additional time required for the calculation of the "full-wave" correction is relatively short. Numerical examples show that for frequencies of about 2 Mc/s this correction cannot be neglected. The method is applied in a preliminary interpretation of observed values of absorption. It is concluded that more than half of the observed absorption occurs less than 2 km below the theoretical height of reflection.

538.56

15169 THE FREQUENCY DEPENDENCE OF IONOSPHERIC ABSORPTION. K.Bibl, A.Paul and K.Rawer.

J. atmos. terrest. Phys., Vol. 16, No. 3-4, 324-39 (Nov., 1959). In German.

Detailed analysis has shown that in most cases where observations did not follow a previous formula $L = B/(f+f_L)^2 + N \cdot \Delta_3(f_0E/f)$, intense echoes from a blanketing E_S-layer were present. The theory is generalized to the case of a thin, mirror-like E_S-layer embedded into a parabolic E-layer (model D). This gives a new function depending on a second parameter given by the altitude of the mirror. By application of the new formula (with the actual parameters of each observation) a much better description of the observed frequency variation is obtained. Noon values of B (non-deviative D-absorption) and N(deviative E-absorption) show opposed seasonal variations, N increasing but B decreasing with the sun's height. The variation of N can be explained satisfactorily by a small decrease of the altitude of the E-layer with increasing height of the sun.

538.56 : 551.5

15170 SUDDEN CHANGES IN THE VIRTUAL HEIGHT OF RADIO WAVES REFLECTED FROM THE E-REGION OF THE IONOSPHERE. J.D.Whitehead.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 99-102 (Oct., 1959).

It has been observed that the virtual-height of radio waves reflected from the E-region shows discontinuous changes. The lower height reflections take place from thin layers within the normal E-region. From the measurements of the associated amplitude changes it has been possible to deduce that the electronic collision frequency at 110 ± 5 km is $(1.3 \pm 0.1) \times 10^4$ per sec and the semi-thickness of the thin layers if 4 ± 2 km.

538.56 : 621.391.812.32

15171 RHYTHMIC FADING OF SHORT-WAVE RADIO SIGNALS. B.N.Singh and R.L.Ram.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 145-55 (Oct., 1959).

The problem of periodic fading due to interference of a number of components of a sinusoidal radio signal is theoretically treated by considering it as equivalent to determining the resultant of a number of simple harmonic vibrations of nearly equal frequencies. The practical bearing of the results so obtained to fading curves of magneto-ionic origin particularly those caused by interference of three and four components is discussed. A number of typical fading curves for short-wave radio signals transmitted from Delhi and Calcutta is described. Particular reference may be made of curves which are very likely of magneto-ionic origin and depict the complete sequence of events expected when the value of the m.u.f. for the F2-layer passes across the signal frequency due to the increase or decrease of the ionic density of the layer. Fading curves which are ascribed to interference between waves singly and doubly reflected from F2-layer and E-layers are also described and their features discussed. An example is also given of such fading curves whose origin appears to be obscure.

538.56 : 52

15172 HIGH FREQUENCY FADING OBSERVED ON THE 40 Mc/s WAVE RADIATED FROM ARTIFICIAL SATELLITE 1957α. G.S.Kent.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 10-20 (Oct., 1959).

A study has been made of high frequency fading observed on the 40 Mc/s wave radiated from the first Russian satellite (1957α). This fading had a frequency of a few cycles per second and it is concluded that it was produced by the passage of the waves through irregularities in the F-region of the ionosphere. The size and spatia distribution of these irregularities has been examined, and it is foun that they are about 1 km in size and that they occur at heights above about 250 km. They usually occur at latitudes greater than 50° N and are more concentrated towards the north. It is likely that their density is controlled by magnetic rather than geographic latitude and there is a tendency for them to be grouped into large areas. These have dimensions of several hundred kilometres and are elongated along the parallels of latitude. Comparison is made of the properties of these irregularities with those believed to be responsible for radio-stellar scintillation and spread-F echoes.

538.56 : 621.391.812.624

15173 DIRECT H.F. BACKSCATTER FROM THE F REGION. H.F.Bates.

J. geophys. Res., Vol. 65, No. 7, 1993-2002 (July, 1960).

Using the records of the oblique-incidence, sweep-frequency (1-25 Mc/s) scatter sounder located at College, Alaska, it was shown that a commonly observed winter daytime echo was direct scatter from a patch of field-aligned F-region irregularities. The range of this particular echo was constant with frequency out to its junction with the least-time-path echo. Because it was not enhanced by any type of focusing mechanism, it was termed a strong-scatter echo. A series of records for December 16, 1958, are shown and discussed in detail. The behaviour of the strong-scatter F-region echo and another F-region direct-scatter echo during the transitional periods of sunrise and sunset indicates that the field-aligned irregularities are distributed randomly over wide areas at night but that during the day they exist only in relatively small patches. From this it is inferred that the sun has a smoothing effect on the ionosphere.

621.391.812.63 : 538.56

15174 THE CALCULATION OF THE M.U.F. FACTOR FOR A NON-PARABOLIC IONOSPHERIC LAYER. M.D.Vickers

J. atmos. terrest. Phys., Vol. 17, No. 1-2, 34-45 (1959).

A method is described for calculating the ray path of a radio wave through the ionosphere as represented by an N(h) profile based on experimental data. A few such paths are calculated and from these are obtained maximum usable frequency factors. These factors are compared with those which would have been obtained had the existing methods of calculation been used. In most cases the differences are less than 4%.

Radiofrequency Spectroscopy Techniques

538.56

15175 PASSAGE EFFECTS IN PARAMAGNETIC RESONANCE EXPERIMENTS. M.Weger.

Bell Syst. tech. J., Vol. 39, No. 4, 1013-1112 (July, 1960).

An attempt is made to classify theoretically paramagnetic resonance signals of inhomogeneously broadened lines occurring under various experimental conditions. The theoretical predictions are checked experimentally. Special emphasis is given to cases in which T_1 is long, and to cases in which the adiabatic condition $\gamma H_1^2 \gg dH/dt$ is violated.

538.56

15176 INTENSITY MEASUREMENTS IN MICROWAVE SPECTROSCOPY THE "ANTIMODULATION" METHOD. A.Dymanus.

Physica, Vol. 25, No. 9, 859-88 (Sept., 1959).

Principle and theoretical background are presented of a new method for the precision measurement of absolute and relative peak intensities of microwave absorption lines. This method, called the "antimodulation" method, can be used with any spectrometer employing molecular modulation. The antimodulation method has been applied in the 1.25 cm wavelength region with a Stark-cavity spectrometer of novel design. As a check on the possibilities of the antimodulation method, measurements were performed on seven lines rising from the J = 1 → 2 rotational transition in carbonyl sulphide CS). But for the l-doublet lines, results of both absolute (standard rror ~ 2.5%) and relative (error 1-2%) measurements are in good greement with calculated values. The measured intensities of the -doublet lines are about 15% too low. This discrepancy cannot be xplained by experimental errors. A possible refinement of the heory is suggested to explain the difference.

538.56

15177 AN ELECTRON PARAMAGNETIC RESONANCE SPECTROMETER EMPLOYING VARIOUS METHODS OF ETECTION. D.Bösnecker.

. angew. Phys., Vol. 12, No. 7, 306-14 (July, 1960). In German.

A detailed description is given of the construction and operation f an instrument using wavelengths near 3 cm. Frequency modu-ation of the source klystron is used when wide resonances are to e measured with high sensitivity. For narrower lines, magnetic modulation of small amplitude is profitably employed instead. The limiting sensitivity at room-temperature is 10^{-11} mole for a line half-width of one gauss. Details are given of a resonator for this instrument which can be cooled to 90°K. J.Sheridan

538.56

15178 SIMPLE HIGH-RESOLUTION NUCLEAR RESONANCE SPECTROMETER. R.Keuning.

Rev. sci. Instrum., Vol. 31, No. 8, 839-43 (Aug., 1960).

Employs a permanent magnet and very simple electronic circuits. A resolving power of better than one part in 10^{8} is obtained with samples of approximately 4.5 mm in diameter, while stability and signal-to-noise ratio are satisfactory.

538.56 : 539.18

ATOMIC BEAM E—H GRADIENT SPECTROMETER. See Abstr. 15672

NUCLEAR AND ATOMIC PHYSICS

539

15179 GLOSSARIA INTERPRETUM. NUCLEAR PHYSICS AND ATOMIC ENERGY.

G.J.Béné, R.Beeler and M.Golub.

Amsterdam/London/New York/Princeton : Elsevier Publishing Company (1960) 213 pp.

Over 2000 terms of nuclear physics and technology are listed (but not defined) in English, French, German and Russian. The list is arranged almost entirely on an English alphabetical base (a few terms are specially listed, out of order, by their meaning), with the corresponding terms in the four languages set out horizontally across a page. For French, German and Russian, there are alphabetical indexes referring to the basic list.

APPARATUS . PARTICLE DETECTORS

539.1.07 : 539.17 : 621-52 : 621.317.7

INSTRUMENTATION FOR A SUBCRITICAL HOMOGENEOUS SUSPENSION REACTOR. See Abstr. 13382

539.1.07

15180 SELF-QUENCHING GEIGER COUNTERS CONTAINING MIXTURES OF PERMANENT GASES. O.Riedel; A.J.L.Collinson, I.C.Demetsopoullos, J.A.Dennis and J.M.Zarzycki.

Nature (London), Vol. 186, 876, 876-7 (June 11, 1960).

Refers to earlier notes by Dennis et al. and other authors on certain self-quenching mixtures, such as Xe—O_2 and A—Xe—O_2—N_2. J.D.Craggs

539.1.07

15181 MEASUREMENT OF WEAK BETA-RADIATION WITH A NEW KIND OF GEIGER—MÜLLER COUNTER ARRANGEMENT. M Marxen.

Elektron. Rdsch., Vol. 14, No. 2, 55-8 (Feb., 1960). In German.

In the measurement of weak β-radiation, the background of γ-radiation, cosmic rays, mesons, and β-radiation from impurities is a limiting factor. The usual arrangement is to reduce γ-radiation by suitable shielding and to avoid counting mesons by surrounding the β-ray counter with a protective ring of counters, with a suitable anti-coincidence circuit. The new arrangement described avoids this large outlay of screening material and protective counters by a single protective counter with a hollow anode into which the β-ray counter can be placed. Background rates of 0.9 per minute were achieved with 2.5 cm of mercury and 20 cm of iron. T.Mulvey

539.1.07 : 621.387.424

15182 REDUCTION OF DEAD-TIME IN HALOGEN-QUENCHED GEIGER COUNTERS. B.B.Trott.

J. sci. Instrum., Vol. 37, No. 9, 336-9 (Sept., 1960).

A new type of charge-reduction has been found with a halogen-quenched X-ray Geiger counter. A practical circuit has been developed which reduces the effective dead-time of the counter by a factor of ten. The dead-times were measured by a new method.

539.1.07

15183 [ULTRAVIOLET] RADIATION ACCOMPANYING PULSES IN A GEIGER—MÜLLER COUNTER.

K.W.Ostrowski and L.Turek.

Acta phys. Polon., Vol.17, No. 2-3, 97-111 (1958).

The radiation was investigated by means of photo-sensitive counters with quartz windows facing one another and connected to a delayed coincidence circuit. Two components of this radiation were distinguished, a stronger component occurring within the limits of 0-2 μsec (prompt radiation) and at least one order of magnitude weaker than a second component occurring with a delay of 2-300 μsec (delayed radiation). The prompt radiation has a continuous spectrum with a maximum at about 2700 A. This radiation is interpreted as radiation from the recombination of argon ions. The delayed radiation is strongly dependent on the counter supply voltage and its intensity can be measured only beginning from about 70 V before the end of the plateau. The maximum intensity of the delayed radiation when the counter is normally filled with an argon and alcohol mixture occurs at about 50 μsec. The delay corresponding to the radiation maximum for a higher argon pressure decreases with an increase in pressure. The delayed radiation is interpreted, in accordance with the Wiser and Krumbein hypothesis as originating from the metastable argon molecules.

539.1.07 : 539.16

USE OF G.M.COUNTERS FILLED WITH A MIXTURE OF CO_2+ CS_2 FOR THE MEASUREMENT OF THE ACTIVITY OF NATURAL CARBON. See Abstr. 15530-1

539.1.07 : 535.33

EFFICIENCY, STABILITY, AND CHARACTERISTICS OF PHOTOSENSITIVE G.M.COUNTERS. See Abstr. 14833

539.1.07 : 525 : 621.387.424

15184 RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES. C.S.Josias.

Proc. Inst. Radio Engrs, Vol. 48, No. 4, 735-43 (April, 1960).

One of the devices carried aboard lunar payloads, Pioneer III and Pioneer IV, was a radiation measurement instrument. Its purpose was to detect and process information on particle flux rates encountered along the nominal cis-lunar trajectory to be followed by those payloads. Radiation data were collected by two different Geiger—Mueller tubes. One tube registered particle counts and the resultant accumulation was stored in a 17-stage scaler. The other tube provided average pulse current that was a compressed function of the counting rate. This current was fed to a resistor and the voltage thus formed was transferred to a telemetering subcarrier oscillator by way of a stable d.c. amplifier. The equipment is described in three groups: (1) d.c. amplifier for the analogue experiment; (2) high-voltage circuitry for the detectors; (3) digital circuitry for the counting experiment. Details of the encoding system, which permits a large dynamic range of counting rates to be clearly presented on a single subcarrier, are also discussed.

539.1.07

15185 ION-CHAMBER RESPONSE IN HIGH-LEVEL RADIATION FIELD. E.G.Bylander.

Nucleonics, Vol. 18, No. 5, 102, 104 (May, 1960).

A 4 cm^3 ion chamber was tested in a 4×10^9 ergs/g (C)/hr gamma-ray field. Results indicated it could be used up to 4×10^{10} ergs/g (C)/hr. Temperature dependence and neutron response were measured. R.D.Smith

539.1.07

15186 PULSED IONIZATION CHAMBER AS AN INSTRUMENT FOR THE SIMULTANEOUS INVESTIGATION OF THE ENERGY AND ANGULAR DISTRIBUTIONS OF CHARGED PARTICLES.

B.A.Bogachov, A.A.Vorob'ev and A.P.Komar.

Zh. tekh. Fiz., Vol. 27, No. 7, 1575-7 (July, 1957). In Russian.

The operation of a two grid ionization chamber is described, which enables very accurate resolution of the spectra of low energy particles from radioactive decays. An elementary theory of the instrument is given. G.Martelli

539.1.07

15187 AUTOMATIC ION CHAMBER CORRECTION FOR TEMPERATURE AND PRESSURE.

E.G.Bylander and J.R.Gardner.

Rev. sci. Instrum., Vol. 31, No. 7, 778-9 (July, 1960).

With very high gamma-ray dose rates, measuring ion chamber temperatures are raised, and vary with dose rate. A pair of Cu—constantan thermocouples was arranged so that the out-of-balance current, due to the temperature variation of the ion chamber, operated a servo potentiometer in the input circuit of the ion current amplifier. A manual potentiometer provided a pressure correction. The device can be used with sealed or open chambers. A schematic circuit diagram is given. D.V.Mabbs

539.1.07

15188 FISSION COUNTER SAMPLE DISK HOLDER AND SLIDE. C.L.Truman.

Nuclear Sci. Engng, Vol. 6, No. 3, 252-3 (Sept., 1959).

Briefly describes an ionization-chamber fission counter for the estimation of U^{235} in uranium compounds. Constructional details are given. J.D.Craggs

539.1.07

15189 NEUTRON FLUX MEASUREMENT AT ELEVATED TEMPERATURES. A.L.Gray.

Nuclear Engng, Vol. 5, 245-8 (June, 1960).

The choice of materials for the construction of ionization and fission counters for operation up to temperatures of 400° and 900°C, respectively, is discussed. A.E.I. Research Laboratory

539.1.07

15190 NEW SCINTILLATORS.
Nucleonics, Vol. 18, No. 5, 88-9 (May, 1960).

A review of developments reported at thr 1960 Scintillator Symposium in Washington. Compositions of scintillating glasses are tabulated — these give pulse heights of up to 14% of NaI (Tl). Xenon and argon at pressures up to 75 atms have been used as scintillators, the walls of the chamber being coated with a wavelength shifter such as diphenyl stilbere. By the addition of nitrogen or neon high sensitivity neutron detectors can be made. CsI(Tl) crystals have been developed which combine the resolution of NaI(Tl) crystals with a higher stopping power. R.D.Smith

539.1.07

15191 THE EFFECT OF TEMPERATURE ON THE EFFICIENCY OF SCINTILLATION COUNTERS.

A.Meessen.

J. Phys. Radium, Vol. 19, No. 4, 437-42 (April, 1958). In French.

Three aspects were studied. (1) The effect of temperature on the scintillator; NaI:Tl was chosen. At low temperatures, lattice emission of NaI was observed, and at very high temperatures the Tl-centre emission band appeared and was transformed at 20 and 100°C. (2) The effect of temperature on the sensitivity of the photocathode. This was apparent as a shift of the spectral response curve towards the red as the temperature was lowered. (3) The effect of temperature on the efficiency of the dynodes. The amplification factor of the dynodes appeared to be increased by the cooling of the photocathode. Existing experimental results are reviewed and compared with those of the author. The interpretation of the different effects is indicated.

539.1.0

15192 LUMINESCENT GLASSES FOR USE IN THE DETECTIC OF NUCLEAR RADIATION.

D.G.Anderson, J.Dracass and T.P.Flanagan.

J. Electronics and Control, Vol. 7, No. 5, 463-4 (Nov., 1959).

Colourless clear glass scintillators are described with conversion efficiencies of 12% compared with NaI:Tl crystals, for electrons and γ-rays. Presence of lithium in the glass provides thermal neutron detection using the n—α reaction. The emission matches the Sb—Cs cathode of a photomultiplier. The decay time o emission is about 10^{-7} sec. An important advantage of the glass scintillator is the large range of sizes and shapes possible. G.F.J.Garlic

539.1.07

15193 SCINTILLATION COUNTING OF CARBON-14. D.S.Jenkinson.

Nature (London), Vol. 186, 613-14 (May 21, 1960).

A method for the radioassay of C^{14} in aqueous solution, suitable for handling large numbers of samples with specific activities of 0.1-10 μc, which does not depend on the chemical form of the carbon or on the colour of the solution is described. A thin (0.127 mm) disk of a plastic phosphor is used as scintillation material to detect the beta particles. The performance of the scintillation counter is discussed and it is concluded that, although the counting efficiency i low, provided sufficient activity is available to give a convenient count rate the method is both rapid and precise. C.F.Barnab

539.1.07 : 535.37 : 532.

THE α/β RATIO OF A LIQUID SCINTILLATOR. See Abstr. 14660

539.1.0

15194 CHERENKOV COUNTERS FOR HEAVY CHARGED PARTICLES. M.Cavallaro and P.Salvadori.

R.C. Ist. Super. Sanita, Vol. 23, Pt 3-4, 330-88 (1960). In Italian.

The general characteristics of Cherenkov counters are described. A number of different types of Cherenkov counters for heavy charged particles (protons, deuterons, α-particles) are critically examined and compared. Cherenkov counters, used in ex periments with well collimated beams produced by high energy particles accelerators, are discussed in detail. Each counter is considered in relation with the use for which it has been designed. A table is presented for a comparison of the characteristics of con struction and performance of the counters used in some experiment

539.1.0

15195 SEMICONDUCTOR DETECTORS.
Nucleonics, Vol. 18, No. 5, 98-100 (May, 1960).

Developments reported at the 1960 Scintillation Counter Symposium in Washington included improved surface barrier counters with a resolution of better than 15 keV for 5.5 MeV alphas, detection of β-particles in the range from ten to several hundred keV and fission fragment detectors with very thin surface layers. Results from the fission fragment detector show the absence of columnar recombination and that the number of electron volts per hole—electron pair is the same for fission fragments as for other particles, though the collection time is slightly longer. Diffused junction detectors have given a linear response to carbon ions of energies up to 120 MeV. A nomogram is included allowing the capacitance of semiconductor detectors to be calculated rapidly. R.D.Smith

539.1.07

15196 CONTRIBUTION TO THE STUDY OF THE DOSIMETRY OF HIGH FLUXES OF IONIZING RADIATIONS.

J.Prévé and G.de Gaudemaris.

C.R. Acad. Sci. (Paris), Vol. 250, No. 21, 3470-2 (May 23, 1960). In French.

Various types of dosimeters — a Victoreen chamber, ferrous sulphate, ferrous sulphate plus copper, ceric sulphate, cyclohexane, and oxalic acid dosimeters — were compared. The gamma radiation from a 15 000 curie Co^{60} source and electrons accelerated to 500 kV were used to measure the performances of the dosimeters. The intensity of the gamma radiation was about 10^6 rad/hr and total doses of up to 6×10^6 rad were used. Details are given of the response of the dosimeters and it was found that the best results were obtained from the cyclohexane and $Ce(SO_4)_2$ dosimeters. C.F.Barnaby

539.1.07

15197 RECORDING PARTICLE TRACKS WITH THE LUMINESCENT CHAMBER.

M.L.Perl and L.W.Jones.

leonics, Vol. 18, No. 5, 92-7 (May, 1960).

In a luminescent chamber two faces of a rectangular scintillator ally NaI(Tl) or a bundle of plastic filaments) are viewed sepa-ly by image intensifier tubes, enabling the actual tracks of high rgy particles to be recorded. Electronic gating with time intervals ess than 1 μs is possible. Properties of typical chambers are lated and the present techniques of using image intensifiers or nsifier image orthicons reviewed. The television system ording directly on magnetic tape will be advantageous when track rmation can be fed directly into a computer. R.D.Smith

539.1.07

15198 AN OPTICAL-MECHANICAL METHOD FOR STEREO-SCOPIC RECONSTRUCTION.

E.Fiorini and S Ratti.

vo Cimento Suppl., Vol. 15, No. 2, 246-53 (1960).

A stereoscopic optical-mechanical method for reconstruction loud and bubble chamber events is described. This method sists essentially of a "material" reconstruction of events. A reoscopic apparatus, based on the method, is at present used to onstruct multiplate chamber events. The performance of the aratus is described and the errors of measurement estimated. simplicity, quickness of reconstruction and the possibility 'space visualizing" reconstructed events make this apparatus considerable use.

539.1.07

15199 CONTROLLED SENSITIVITY BUBBLE CHAMBER WITH STABILIZED FINAL PRESSURE.

Hahn, A.W.Knudsen and E.Hugentobler.

ovo Cimento Suppl., Vol. 15, No. 2, 236-45 (1960).

A radiation sensitivity stabilized 2-litre bubble chamber operating h $CBrF_3$ or fluorocarbon gas—liquid mixtures near room tempera-e is described. Final pressure stabilization is achieved by a thod first suggested by Blinov et al. Flat bottomed pressure lses 30 msec long, and corresponding bubble density plateau with ble density variations smaller than ±5% have been obtained. The amber sensitivity is reproducible at any time and can be adjusted stantaneously to the desired bubble density. The chamber is also nperature stabilized. Accurate bubble counting for particle locity determinations is possible without a reference track in each bble chamber picture. A discussion is presented, on how to nimize undesired pressure oscillations, and on the possibility of essure stabilizing much larger chambers.

539.1.07

15200 A 10 IN. DIAMETER LIQUID HYDROGEN BUBBLE CHAMBER.

.H.Alston, D.C.Cundy, W.H.Evans, R.W.Newport and P.R.Williams.

il. Mag. (Eighth Ser.), Vol. 5, 146-53 (Feb., 1960).

The important design features of a 10 in. hydrogen bubble amber, its magnet and the associated control circuitry are des-ibed and illustrated.

539.1.07

15201 SYSTEMATIC TRACK DISTORTION IN A 10 in. DIA-METER LIQUID HYDROGEN BUBBLE CHAMBER.

C.Cundy, W.H.Evans, D.W.Hadley, P.Mason, R.W.Newport, R.Smith and P.R.Williams.

il. Mag. (Eighth Ser.), Vol. 5, 154-60 (Feb., 1960).

An investigation has been made of the dependence of systematic ack distortion in a 10 in. diameter liquid hydrogen bubble chamber on track position in the chamber, beam entry time and flash delay. is seen that provided photography occurs before recompression distortions are small compared with the multiple scattering rvature, and are not significantly different from zero except at the treme top and bottom of the chamber.

539.1.07

15202 THE DEVELOPMENT OF A FAST BUBBLE CHAMBER.

C.Andelfinger.

angew. Phys., Vol. 12, No. 3, 99-107 (March, 1960). In German.

A propane bubble chamber was operated with a fast and a normal pansion system. When operated with the normal system a value of p/dt) = 7.5 × 10^3 atm/sec was obtained for the expansion velocity, ile with the fast system 2.5 × 10^5 atm/sec was reached. The nsitivity of various regions of the working volume was studied at rious times during the expansion. With the fast system the amber became sensitive 250 μsec after the initiation of the expan-on, compared with 2.5 msec obtained with the normal system. These measurements showed that the mean life of the latent bubble nuclei is shorter than 10 μsec. A description of the device and some photographs of tracks taken under different operating conditions are given. G.Martelli

539.1.07

15203 IDENTIFICATION OF PARTICLES IN HIGH-ENERGY STARS.

G.I.Kopÿlov.

Zh. eksper. teor. Fiz., Vol. 37, No. 2(8), 557-8 (Aug., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37, No. 2, 393-4 (Feb., 1960).

A simplification of the usual method of particle identification by momentum analysis of a star is obtained if the angular correlations between the other charged particles are taken into account. S.J.St-Lorant

539.1.07

15204 DETERMINATION OF CELL NOISE FROM CROSSED PRODUCT TERMS IN THE SECOND DIFFERENCES OF THE SAGGITTA METHOD.

B.Dépaux, S.Desprez-Rebaud and Tsai-Chii.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4343-5 (June 27, 1960). In French.

From measurements of the saggittas on 2 GeV and 6 GeV proton tracks for different cell lengths, the cell noise due to the emulsion itself is found. It is shown that, for cell lengths of 50 μ and 100 μ, the noise due to the measurements themselves is much greater than the noise due to the emulsion. A quantitative discussion of the total noise is given. R.H.Thomas

539.1.07 : 550.9 : 539.16

AN EMULSION STUDY OF RADIOACTIVITY OF PEGMATITE. See Abstr. 13163

539.1.07 : 539.12

IONIZATION IN EMULSIONS AT THE ORIGINS OF ELECTRON PAIRS. See Abstr. 12911

539.1.07 : 539.12

STUDY OF PION PRODUCTION WITH NUCLEAR EMULSIONS. See Abstr. 13047

539.1.07 : 537.59

COSMIC-RAY ENERGY MEASUREMENT IN NUCLEAR EMULSIONS. See Abstr. 13089

539.1.07 : 537.59

THE ABSORPTION OF COSMIC RAYS IN LEAD MEASURED WITH NUCLEAR EMULSIONS. See Abstr. 13090

539.1.07

15205 THE APPLICATION OF LOW SENSITIVITY EMULSIONS TO THE IDENTIFICATION OF HEAVY IONS.

C.Gegauff and J.P.Lonchamp.

J. Phys. Radium, Vol. 20, No. 10, 797-803 (Oct., 1959). In French.

Reviews all the experimental facts showing that heavy ion tracks in nuclear emulsions are formed of two distinct parts "primary" and "secondary". The determination of the specific energy loss of the "primary part" of the track suggests a method of identification of heavy ions (Z = 6, 7, 8, 10 and 18) recorded in low sensitivity emulsions (Ilford K_0, K—1, K—2). Several means of identification are discussed: length without gaps at the end of the track, number of gaps counted from the end of the track. It is possible to identify the ions with an accuracy of one unit of charge.

539.1.07

15206 ON THE GRAIN DENSITY IN ILFORD G-5 EMULSION OF SINGLY CHARGED RELATIVISTIC PARTICLES.

B.Jongejans.

Nuovo Cimento, Vol. 16, No. 4, 625-43 (May 16, 1960).

The grain density in nuclear emulsion has been determined as a function of the value of $(\gamma-1)$ of the particle producing the track. Values of the parameter $(\gamma-1)$ between 0.8 and 10^3 were taken into consideration. The number of blobs per unit length has been directly determined. Transformation of blob density into grain density has been carried out. Care has been taken to relate all determinations to each other, a constant scale of reference being found in pions of momentum between 5.2 and 5.7 GeV/c. The results are in agreement with the theory given by Sternheimer. The value (501 ± 8) eV was used for the ionization potential of AgBr in the present work. This value was taken from Barkas. The cut-off energy consequently determined is 100 keV. It is shown that the results are not very sensitive to this last value.

539.1.07

15207 REDUCTION OF SPURIOUS SCATTERING IN ILFORD G-5 AND K-5 EMULSIONS. B.Judek.

Nuovo Cimento, Vol. 16, No. 5, 834-47 (June 1, 1960).

In an attempt to reduce the amount of spurious scattering in the emulsions, two batches of Ilford G-5 and two batches of Ilford K-5 stripped emulsions, 600 μm thick, have been exposed to the 6.2 GeV internal proton beam from the Berkeley Bevatron, and developed in several different ways. The methods of development used included isothermal development at 5° C, 10° C and 15° C and temperature cycle development with the warm stages at 10° C, 15° C and 20° C with the plates immersed in a boric acid—potassium bromide solution. For comparison some emulsions were also developed with the "dry", warm development at 25° C which was usually employed in previous work. As a further precaution against distortions in the emulsions potassium alum hardener was added to the fixing bath, and the emulsions were dried slowly at a temperature below 10° C. Scattering measurements performed on the 6.2 GeV proton tracks in the emulsions have shown that the spurious scattering has been reduced to about half of the value which has usually been obtained previously and by other workers. This applies to all the plates, except for a G-5 emulsion from one batch and developed at 25° C. It has been observed that the amount of spurious scattering depends on the development temperature: (i) It does not change between temperatures of 5° C and 10° C. (ii) Above 10° C there is a gradual increase with temperature. (iii) In some batches of emulsions a marked increase of spurious scattering occurs at a temperature of about 25° C. Some variation in the amount of spurious scattering present in the different batches of emulsions used has been observed, but there appears to be no difference in that respect between the G-5 and the K-5 emulsions. Good grain densities on minimum tracks and improved uniformity of development with depth in both the G-5 and the K-5 emulsions have been obtained using the temperature cycle methods of development with warm stages at 10° C, 15° C and 20° C.

539.1.07

15208 FADING OF MINIMUM TRACKS IN ILFORD G-5 AND K-5 EMULSIONS. B.Judek.

Nuovo Cimento Suppl., Vol. 15, No. 2, 161-5 (1960).

The fading of plateau electron tracks in Ilford G-5 and K-5 emulsions, stored after exposure at temperatures of 20° C, −1° C, −18° C and −40° C, has been compared. It has been found that the same initial grain densities are obtained on tracks in both G-5 and K-5 emulsions with identical development one day after the exposure, while the rate of fading is lower in K-5 than G-5 emulsions. The results also show that the rates of fading in both emulsions are much higher at 68° F than at the lower temperatures. After four weeks at 20° C there is a marked effect, the reduction in blob densities being 41% in G-5 and 38% in K-5 emulsions. In emulsions stored at 0° F, on the other hand, even for 2½ months after the exposure, easily recognizable electron tracks have been obtained with blob densities reduced by only 18% and 13.5% respectively. No significant difference between the rates of fading at −1° C, −18° C and −40° C could be detected. It was also found that fading is much more rapid during the first two weeks after the exposure than during a later period.

539.1.07

15209 A SIMPLE FINDER ATTACHMENT TO A MICROSCOPE. USEFUL IN THE EXAMINATION OF GRID-BACKED NUCLEAR EMULSION PLATES, OR GLASS SLIDES.

W.B.Lasich.

Nuovo Cimento Suppl., Vol. 15, No. 2, 166-8 (1960).

A microscope attachment which facilitates the reading of the position coordinates associated with nuclear events heated in photographic emulsions is described. By diversion of light into a small finder telescope an image corresponding to the plane of the reference grid may be independently sighted, thus eliminating the need for readjustments of the microscope.

539.1.07

15210 A POSSIBLE METHOD OF SPECIFIC CHARGE IDENTIFICATION FROM PROFILE MEASUREMENTS IN NUCLEAR EMULSIONS. R.G.Ammar.

Nuovo Cimento Suppl., Vol. 15, No. 2, 181-92 (1960).

This is a discussion of a method of specific charge identification in nuclear emulsions (e.g. 1200 μ thick K-5 pellicles processed unmounted) requiring ~ 50 μ projected range. Using a constant cell length ℓ, the width of the track T_n was measured at each residual range $n\ell$, yielding a distribution $\{T_n\}$. Typically $\{T_n\}$ consisted of 100 measurements made at a basic cell length $\ell \cong 0.57\ \mu$. Each was subjected to about three such measurements in order to est mate the measurement errors. The mean $\bar{T}$ and standard spre of this distribution, which are conventional charge sensitive par meters, often require normalizations for best results. A searc amongst the dimensionless parameters associated with the distr tion $\{T_n\}$ indicates that the third moment of the distribution, $\alpha_3 \equiv \sum_n (T_n - \bar{T})^3/\sigma^3$, is a charge sensitive parameter. A truncat distribution $\{T'_n\}$ with mean $\bar{T}'$, spread σ' and skewness $\alpha(p\sigma')$ i derived from $\{T_n\}$ by replacing all $T_n > \bar{T}' + p\sigma'$ by $\bar{T}' + p\sigma'$. α(with $p = 3.75$ is found to be the most sensitive parameter of tho tried. It is presumed that its ability to discriminate is based on presence of "sub δ-rays" and the tendency to form gaps. The principal limitation arises at present from the rather large mea urement errors. The observed efficiency of discrimination (~ 8 is consistent with what would be expected from these errors onl The possibility of utilizing α together with the mean track thick in order to infer the mass of the particle, is also discussed.

539.

15211 A COMPACT PROCESSING PLANT FOR THICK NUCLEAR EMULSIONS.

J.E.Hooper, E.Dahl-Jensen and E.B.Neergaard.

Nuovo Cimento Suppl., Vol. 15, No. 2, 211-35 (1960).

A processing plant for large nuclear emulsion stacks is described. A "wet" development procedure, which has been fou yield satisfactory results is discussed, together with certain mo specific problems, such as the surface deposit of silver and the of silver removal from the emulsion during fixation.

539.

15212 ADAPTATION OF A COMMERCIAL DOMESTIC REFRIGERATOR FOR DEVELOPMENT OF NUCLE EMULSIONS. A.H.Armstrong, G.M.Frye, Jr and L.Rosen.

"Particle photography" Conference. Montreal, 1958 (see Abstr. of 1960) p. 153-8. In French.

Describes briefly emulsion processing facilities suitable fo laboratories with restricted darkroom space. S.J.St-Lo

539.1.07 :

15213 THE INFLUENCE OF THE pH AND THE pAg OF EMULSIONS ON THE REGRESSION OF THE LATEN IMAGE PRODUCED BY CHARGED PARTICLES.

H.Gauvin and W.Sebaoun.

"Particle photography" Conference. Montreal, 1958 (see Abstr. 2261 of 1960) p. 228-32. In French.

Using the Ilford C2 emulsion gel, modified by the addition o sulphuric acid (pH) and/or a solution of KBr (pAg), the fading properties of the emulsion were examined. It is concluded that neither pH nor pAg influences the sensitivity of C2 emulsion critically, but that the regression of the latent image produced b the changed ionic concentrations appears to be an additive pheno non. S.J.St-Lo

539.1.07 :

15214 THE PARTICLE LATENT IMAGE AT HIGH TEMPERATURES. R.Rechenmann.

"Particle photography" Conference. Montreal, 1958 (see Abstr. 2 of 1960) p. 233-6. In French.

Reports the effect of elevated temperatures on formation of latent image in the Ilford G5 and C2 emulsions exposed to β-ray The results show that between 20° and 100° C and over a range of 5 min to 2 hours, the fog density remains sensibly constant, irre pective of the type of developer used. A decrease in the sensitiv of the G5 emulsion takes place at elevated temperatures if a solv developer is used, whereas surface developers tend to enhance t sensitivity. The sensitivity of the C2 emulsion appears to increa with the temperature. S.J.St-Lor

539.1.07 :

15215 THE DISCRIMINATION BETWEEN RADIATIONS BY POST-EXPOSURE TO INFRARED LIGHT AND THE CRITICAL, QUANTITATIVELY CONTROLLABLE, DEVELOPME WITH INORGANIC REAGENTS. H.Braun.

"Particle photography" Conference.Montreal, 1958 (see Abstr. 2 of 1960) p. 247-50. In French.

The critical potentials of ferro-oxalate-based developers ar determined as a function of the KBr concentration and of differen types of emulsion over a temperature range from 5 to 18° C. A post-exposure to infrared light appears to enhance the resolving power of the emulsions; a procedure is described whereby α-particles can be distinguished in a heavy γ-background.

S.J.St-Lor

539.1.07 : 537.533

216 PHOTOGRAPHIC MATERIALS FOR BETA AUTO-RADIOGRAPHY.

ogomolov, M.U.Deberdeiev, A.A.Sirotinskaya and V.M.Ouvarova.
icle photography" Conference. Montreal, 1958 (see Abstr.
of 1960) p. 445-9. In French.

brief review of the techniques and materials used for autoradio-
y of beta-active preparations. Illustrations are drawn from a
er of fields, especially from electron microscopy.

S.J.St-Lorant

539.1.07

217 THE HIGH FREQUENCY PROPERTIES OF A COAXIAL CABLE AND THE DISTORTION OF FAST
SES. G.Fidecaro.

Cimento Suppl., Vol. 15, No. 2, 254-63 (1960).

This is discussed mathematically and a convenient way of deter-
ng accurately the delay of a coaxial cable is also shown.

539.1.07 : 621.374.32

5218 ANTI-COINCIDENCE CIRCUIT FOR USE IN THE MILLI-MICROSECOND REGION. R.Madey and D.A.Barge.

sci. Instrum., Vol. 31, No. 6, 664-5 (June, 1960).

A simple crystal diode anti-coincidence circuit that can be
ated by 4 mμsec pulses is described. At 10 mμsec about the
cident time the response is reduced by 200 times.

D.Walsh

539.1.07 : 621.374.33

5219 TIME-SORTER FOR USE IN THE NANOSECOND RANGE.
G.Jones.

i. Instrum., Vol. 37, No. 9, 318-23 (Sept., 1960).

Presents the design of a time-to-amplitude conversion circuit
oying delayed fast coincidence techniques for use in the nano-
nd region. This circuit has a linear time calibration over the
e 1 to 10 ns, a resolution time of less than 0.05 ns and a varia-
of time calibration less than 0.03 ns per day is achieved. A reso-
n time of 0.8 ns was found when detecting coincidence between
ys from a Co^{60} source.

539.1.07

5220 REMARKS ON EVALUATION OF THE SPURIOUS COUNTS IN COINCIDENCE MEASUREMENTS.

migliana.

rgia nucleare, Vol. 7, No. 7, 495-6 (July, 1960).

The methods of evaluation of the spurious counts in coincidence
surements done by means of radiation detectors are discussed
e particular case of a radiation source that decays with the
ssion in cascade of two simultaneous and correlated radiations,
resence of random noise pulses.

539.1.07

5221 A MAGNETIC SPECTROMETER FOR CHARGED PARTICLES. S.B.Karmohapatro.

an J. Phys., Vol. 33, No. 3, 139-47 (March, 1959).

A Siegbahn—Svartholm type magnetic spectrometer, designed
ocussing of ~1 MeV protons is described with constructional
ils. Results of the measurement of the magnetic field and its
lient are given. Performance of the instrument in the low field
on is tested with the conversion electron spectrum of a Cs^{137}
ce. Experiments showing the resolution, dispersion and the axial
ssing properties of the spectrometer are presented.

539.1.07

15222 SIMPLE METHOD FOR CALIBRATION OF MAGNETIC ANALYZERS FOR NUCLEAR ACCELERATORS.

.Hamburger.

. sci. Instrum., Vol. 31, No. 7, 777-8 (July, 1960).

Shows how, under certain conditions, a magnetic analyser may
sed to determine particle energies accurately even if its cali-
tion function is not known. As an example the reactions
^{26}(d,d)Mg^{26} and Mg^{26}(d,t)Mg^{25} are considered with an incident
teron energy of ~15.0 MeV. It is shown that an uncertainty of
duct momentum of 10% only leads to an uncertainty of ~9 keV
i.

R.H.Thomas

NUCLEAR FIELD THEORY

539.11

15223 TCP AS A SPACE REFLECTION.
E.Lubkin.

Nuovo Cimento, Vol. 15, No. 1, 153-5 (Jan. 1, 1960).

Examines in what sense TCP invariance alone may provide for left—right symmetry.

W.A.Hepner

539.11

15224 FIELD METRICS.
P.Sen.

Nuovo Cimento, Vol. 15, No. 4, 513-18 (Feb. 16, 1960).

A correlation between the metric along which a field propagates and its commutation relations or Feynman propagation function is postulated and the metrics for the fields whose wave equations are known or the wave equations for the fields whose metrics are known are deduced. The metrics of known fields are seen to have simple quadratic forms which define the interaction terms uniquely and from such metrics the interaction terms for nucleon meson, β decay and μ decay interactions are derived.

539.11

15225 A SOLUBLE MODEL IN FIELD THEORY. II. UNSTABLE PARTICLE AND BOUND STATE DESCRIPTION.
E.Kazes.

Nuovo Cimento, Vol. 15, No. 4, 537-50 (Feb. 16, 1960).

Examining a model presented in Pt I (Abstr. 2482 of 1960) a calculation is made of unstable particle production and decay without separating these two processes. The usual separation of production and decay is seen to be valid for a time t, such that

$$\frac{h}{\mu_3 c^2} \ll t \ll 2\tau \ln 2\pi\tau t^2 Q^3, \qquad Q \gg \frac{1}{\tau},$$

where Q is the energy above threshold for unstable particle production and τ is the lifetime. When the above conditions are valid the unstable states possess a simple enough time development to be characterized with a particle label. The model also predicts bound state production for suitable cut-off functions. The Nishijima—Zimmermann formalism for handling bound states in conjunction with dispersion relations reproduces direct calculations.

539.11

15226 HAAG'S THEOREM IN A FINITE VOLUME.
P.Federbush.

Nuovo Cimento, Vol. 15, No. 6, 932-3 (March 16, 1960).

The question of extending Haag's theorem (Abstr. 5864 of 1955) to a finite volume is explored. A positive result is suggested.

539.11

15227 ON THE ORIGIN OF SUPER-SELECTION RULES.
S.T.Epstein.

Nuovo Cimento, Vol. 16, No. 2, 362-4 (April 16, 1960).

It is shown that all the usually assumed super-selection rules follow from the fact that in any experiment one starts with definite numbers of each kind of particle.

539.11

15228 QUANTUM FIELD THEORY IN TERMS OF EUCLIDEAN PARAMETERS. T.Nakano.

Progr. theor. Phys., Vol. 21, No. 2, 241-59 (Feb., 1959).

Quantum field theory in terms of Euclidean parameters is shown to be equivalent to the conventional theory in terms of the Minkowski parameters if it is confined to the case of local fields, and it is suggested that the former is more adequate to describe the internal structure of an elementary particle than the latter. There is no necessity that the parameter space of field theory be Minkowski, because it has no direct connection with the macroscopic space. It is enough that expectation values of observable quantities are covariant under Lorentz transformations. The theory satisfies this requirement.

539.11

15229 ON THE REPRESENTATION OF FIELD QUANTITIES. II. H.Wakita.

Progr. theor. Phys., Vol. 21, No. 2, 299-314 (Feb., 1959).

For Pt I, see Abstr. 12813 of 1960. The problem is studied of whether the framework of a Hilbert space is adequate to the quantum theory of fields. The characteristic features of field theory and their description in this framework are examined. For this purpose the character of additive field quantities, which are used in this paper in place of field operators are studied, and the relation between a system extending over the whole space and one restricted within a finite volume. It is concluded that there is sufficient reason to treat the quantum theory of fields within the framework of a Hilbert space.

539.11

15230 Q-VALUE DEPENDENCE OF DECAY PROBABILITY.

K.Fujii and K.Iwata.

Progr. theor. Phys., Vol. 21, No. 1, 207-9 (Jan., 1959).

It is suggested that the decay probability of a particle (into two decay products) is a decreasing function of the Q-value. For K^+ decays, the matrix element is fitted with an exponential dependence on Q. D.W.L.Sprung

539.11

15231 AN ATTEMPT TO GEOMETRIZE MESOELECTRODYNAMICS.

J.Rayski.

Acta phys. Polon., Vol. 17, No. 2-3, 187-98 (1958).

The basic assumption is that the world is a four-dimensional manifold of infinitesimal surface elements. The (two independent) basic vectors i_5, i_6 tangential to the surface element are independent of the basic vectors i_1, i_2, i_3, i_4, in the Minkowski space but, together with them, span a six-dimensional vector space. The vectors i_1, i_2, i_3 are real, i_4, i_5, i_6 imaginary. Rotations in the (i_5, i_6)-plane mean gauge transformations. The vector space spanned by the imaginary vectors i_4, i_5, i_6 can be interpreted as the isospace. The privileged "third" axis in it is nothing else but the time axis. Such an extension of the physical space makes possible a geometrical interpretation of gauge transformations, charge conjugation, and isotopic spin transformations. It enables one to amalgamate the electromagnetic and mesic fields with geometry in a similar way as the gravitational field has been amalgamated with geometry. The extension of physical dimensions provides an explanation why the pion must be ps-scalar. It accounts for the difference between the charge and the baryon number, and enables one to understand why only baryons (but not leptons) constitute the source of nuclear forces.

539.11

15232 SOME INTEGRAL REPRESENTATIONS IN FIELD THEORY.

R.F.Streater.

Nuovo Cimento, Vol. 15, No. 6, 937-48 (March 16, 1960).

It is shown that the properties of positive mass and energy, and of causality lead in quantum field theory to problems in the theory of analytic completion. A representation for the double commutator previously proved the most general is stated, and its connection with analytic completion noted. A similar representation for the triple commutator is proved to satisfy causality and the positive mass and energy condition, but is not shown to give all the functions with these properties. A conjecture about the envelopes of holomorphy of domains occurring in the discussion of analytic properties of the four-point Green's function is made. Integral representations for the n-fold multiple commutator are proposed, and for some other combinations of Wightman functions. These representations lead to some results in analytic completion.

539.11

15233 ON A CONVERGENT NON-LOCAL FIELD THEORY. I.

E.Arnous, W.Heitler and Y.Takahashi.

Nuovo Cimento, Vol. 16, No. 4, 671-82 (May 16, 1960).

A non-local field theory is developed (and formulated in interaction representation) with the view of obtaining a converging theory. At least one special type of form factor is known for which this theory converges throughout, but in this and the following paper the form factor is not specified (it may even be a q-number). The view is taken that convergence should take precedence over exact Lorentz-invariance, because present knowledge does not necessarily exclude a violation of Lorentz-invariance inside the source. It is shown that the total charge is the same as in local theory and is conserved, provided only that the form factor commutes with the field operators. The invariance against groups of transformations is discussed in a general way and for the special case of Lorentz-transformations. It is shown that the Schrödinger equation can always be formulated in an invariant manner, but that this does not imply the invariance of the S-matrix. The conditions for the invariance of the S-matrix are derived. The theory contains the local theory as a special case.

53

15234 ON A CONVERGENT NON-LOCAL FIELD THEORY.

E.Arnous, W.Heitler and L.O'Raifeartaigh.

Nuovo Cimento, Vol. 16, No. 5, 785-805 (June 1, 1960).

The general theory of Pt I is formulated for the case of quan
electrodynamics. The Lorentz-condition, the gauge transformati
the connection between potentials and (gauge invariant) field stre
and the (divergence free) current density j_μ all require generalizations which are given. The Schrödinger equation is shown to b
gauge invariant and the condition for the gauge invariance of the
matrix is derived. Throughout the form factor is left open. It is
shown that the space integral of j_0 reduces to the ordinary total charge (if the form factor commutes with the field operators). The canonical energy-momentum vector is formally the same as
local theory (the difference lies in the different Hamiltonian). Th
possibilities for obtaining a gauge invariant energy-momentum vector are discussed.

539

15235 THE LAGRANGE FUNCTION IN A GENERAL PROBL

M.Borneas.

Nuovo Cimento, Vol. 16, No. 5, 806-10 (June 1, 1960).

A general formalism, based upon the use of a Lagrange funct
with n-order derivatives with respect to σ independent variables,
presented.

53

15236 AN ATTEMPT OF A NONLINEAR FIELD THEORY.

H.Kita.

Progr. theor. Phys., Vol. 19, No. 4, 454-6 (April, 1958).

A unified field theory is proposed, in which it is assumed tha
there exists only a basic spinor field $\Psi(x)$, which satisfies the no
linear equation $\gamma^\mu(\partial/\partial x_\mu - \Gamma_\mu)\Psi = 0$, where $\gamma^\mu_{(x)}$, $\Gamma_\mu(x)$ and the metric tensor $g_{\mu\nu}$ are functions of Ψ. Definitions are given for th
energy-momentum tensor and the charge-current density.
A.M.Gr

53

15237 INTEGRAL REPRESENTATION OF A DOUBLE COMMUTATOR.

K.J.Le Couteur.

Nuovo Cimento, Vol. 16, No. 2, 227-9 (April 16, 1960).

Dyson's integral representation for the vacuum expectation value of a double commutator is put into a form consistent with th
Jacobi identity.

539

15238 THE RUIJGROK—VAN HOVE MODEL OF FIELD THEORY IN TERMS OF "DRESSED" OPERATORS.

J.Łopuszanski.

Physica, Vol. 25, No. 9, 745-64 (Sept., 1959).

A "dressing" transformation for this model is given. By me
of this transformation the Hamiltonian is expressed in terms of "dressed" operators only. It is shown that the Hamiltonian deper
explicitly on the cut-off. The solution of the eigenvalue problem
given for one meson present in addition to the dressed nucleon. I
also depends on the cut-off. A ghost state with a negative norm as well as a bound state with a positive norm are found, both belonging to the same energy value. The solution for one nucleon and several mesons is outlined. A detailed discussion of the met
in Hilbert space is given. It is shown that the "bare" particle representation is not adequate to describe the system considered
The most suitable representation, from the physical and mathematical point of view, seems to be the asymptotic stationary state
representation, introduced by Van Hove. A test as to the merits
these two representations is given in the the case of an indefinite metric; here the "bare" particle representation can no longer be used to describe the system, in contrast to the asymptotic station
states representation which can be employed with success.

539

15239 ON THE INTEGRATION OF A CERTAIN MATRIX ELEMENT $\langle 0|f^{(2)}(x)|q, k\rangle$ IN THE PERTURBATION APPROACH OF QUANTUM ELECTRODYNAMICS.

H.Wilhelmsson and A.Kerman.

Ark. Fys., Vol. 17, Paper 8, 149-56 (1960).

539

15240 THE GAUGE PROPERTIES OF GREEN'S FUNCTION IN QUANTUM ELECTRODYNAMICS.

S.Okubo.

Nuovo Cimento, Vol. 15, No. 6, 949-58 (March 16, 1960).

Effects of a change of gauge on the Green's functions are stu
systematically in quantum electrodynamics and relations between Green's functions under two different gauges are given.

539.11

5241 A COMPACT EXPRESSION FOR S-MATRIX ELEMENTS IN THEORIES WITH SEVERAL INTERACTING FIELDS.

.Halpern.
vo Cimento, Vol. 16, No. 6, 1085-91 (June 16, 1960).

A compact method of expressing the n-th order S-matrix
nent in quantum electrodynamics has been given by Caianiello
str. 6270 of 1954). The generalization of this formula to n-
racting fields of arbitrary character is considered here. The
cific example of the quantum electrodynamics of spin-0 mesons
reated. Although only two fields are present there are several
ractions because of the e^2 term in the current and because of
meson—meson renormalization term. Using these methods a
demonstration is given of the theorem that the terms in an
ansion of the S-matrix that depend on the orientation of a family
pace-like surfaces vanish identically.

539.11

5242 FORMULAS FOR THE MATRIX ELEMENTS OF CONNECTED DIAGRAMS IN FIELD THEORIES.

.Halpern.
vo Cimento, Vol. 17, No. 2, 244-50 (July 16, 1960).

A concise formula for an element of the S-matrix has been
en by Caianiello (Abstr. 6270 of 1954) in terms of the real particles
earing in the process. This formula contains in addition to the
tributions of the diagrams that describe mutual interactions of
the interacting particles with each other, the contributions of
oint processes occurring simultaneously. In the present note a
hod of factoring out unwanted disconnected pieces is given. As
example the removal of vacuum—vacuum transitions in quantum
trodynamics is carried out.

539.11

15243 ON THE RENORMALIZATION OF THE AXIAL VECTOR COUPLING CONSTANT IN β-DECAY.

ernstein, M.Gell-Mann and L.Michel.
ovo Cimento, Vol. 16, No. 3, 560-8 (May 1, 1960).

The models of the axial vector current discussed by Gell-Mann
Levy are examined further. Generalized Ward identities are
ived for the axial vector weak vertex. It is then shown that in
σ model and the non-linear model the renormalization factor
$_A/G$ may be expressed as a matrix element in the theory of strong
eractions. Thus in the σ model, which is renormalizable,
$_A/G$ is finite in every order. Since $-G_A/G$ exhibits divergences
the non-linear model, that model is not renormalizable in the
ial sense.

539.11

15244 THE INTERACTION OF THE GENERAL VECTOR FIELD WITH AN ELECTROMAGNETIC FIELD AND A MPARISON WITH THE FIELD OF MAXIMUM SPIN 1 OF THE SION THEORY. K.H.Tzou.

Phys. Radium, Vol. 19, No. 2, 119-21 (Feb., 1958). In French.

In the absence of external fields, the spin states 1 and 0 have no
tual interaction in the case of the general vector field as in the
se of the field of maximum spin 1 of the fusion theory. The inter-
ion with an electromagnetic field puts explicitly in evidence the
erference effect of the two spin states of the first field, while
spin states of the second remain always independent with no
tual interference. The electromagnetic interaction shows there-
e clearly the physical difference between the two fields as
ncerning their internal structure with regard to spin states.

539.11

15245 STATES OF AN ISOBARIC PAIR.

R.Nataf.
Phys. Radium, Vol. 20, No. 4, 470-6 (April, 1959). In French.

The degeneracy of the states of two isobaric particles (with their
tiparticles), in the absence of any electromagnetic field, is ana-
sed within the frame of present field theory: 1) When these par-
les are fermions (nucleons). 2) When they are bosons (K mesons).
e quantization of the associated fields being then derived from
ferent commutation rules, the degeneracy for bosons has a higher
der: it involves the four states of particles and antiparticles. The
oup of transformations between these states contains a sub-group
momorphic to rotations in a four dimension space with Minkowski
etric. 3) These degeneracies are compared with that resulting from
harge" uncertainty on the four states of the neutrino-antineutrino
ir.

539.11

15246 ON THE SYMMETRIES OF STRONG AND WEAK INTERACTIONS. F.Gürsey.

Nuovo Cimento, Vol. 16, No. 2, 230-40 (April 16, 1960).

A model of strong interactions is proposed which admits a group ($G_4 \times H$) in the limit of a suitably defined doublet approximation, G_4 being a 4-dimensional extension of the isotopic spin group and H the hypercharge gauge group. Weak interactions having phenomenological chirality invariance properties or obeying the $\Delta I = \frac{1}{2}$ rule are shown to be invariant under an unitary subgroup of the group ($G_4 \times H$).

539.11

15247 ON THE INFLUENCE OF WEAK INTERACTIONS ON ELECTROMAGNETIC PROPERTIES OF FERMIONS.

A.M.Brodski and D.Ivanenko.
Nuovo Cimento, Vol. 16, No. 3, 556-9 (May 1, 1960).

Starting from the product of two currents for the description of Fermi-type interactions, one gets in the case of an external variable electromagnetic field a new specific effective kinematic magnetic moment in the equations of particles.

539.11

15248 ON THE DOUBLE COMPTON PROCESS AND SOME CALCULATIONS OF POLARIZATION EFFECTS. II.

M.Carrassi and G.Passatore.
Nuovo Cimento, Vol. 16, No. 5, 811-28 (June 1, 1960).

Using a method already developed in Pt I (Abstr. 327 of 1960), the transition amplitudes among the basic polarization states of all particles involved in the double Compton effect have been deduced and numerically calculated. The cross-section and various polarization effects have also been discussed in several cases. The cross-sections as a function of the energy of one of the emitted photons show in general an infrared divergence at the ends of the spectrum, a forward concentration with the increase of the incident energy, and in the case of symmetric geometry for the two photons, a minimum when the energies of the emitted photons are nearly equal. Some effects of linear and circular polarizations are considered in detail and a comparison with the single Compton effect made. Linear polarization effects show some qualitative difference from the single Compton scattering.

539.11

15249 REMARKS ON THE APPEARANCE OF GHOST STATES IN RELATIVISTIC FIELD THEORIES.

E.Ferrari and G.Jona-Lasinio.
Nuovo Cimento, Vol. 16, No. 5, 867-85 (June 1, 1960).

A subtraction procedure to eliminate ghosts from propagators proposed by Redmond (Abstr. 2054 of 1959) is examined from the standpoint of axiomatic field theory. This procedure is found to be equivalent to the introduction of a special vertex function which in principle can be chosen among functions having the analyticity properties prescribed by the axioms. This situation is shown to exist both in the case of boson and fermion fields. In the above discussion Lehmann integral representation of propagators is taken as an axiom by itself. The modifications brought into the discussion of ghost problems by a subtracted Lehmann dispersion formula are then examined. Of some interest are the consequences on the high frequency behaviour of form factors.

539.11

15250 AN ATTEMPT OF GENERALIZING THE INVARIANCE OF THE THEORY UNDER THE CHARGE CONJUGATION.

O.Hara, Y.Fujii and Y.Ohnuki.
PION-NUCLEON INTERACTION ACCORDING TO THE PREVIOUS THEORY. O.Hara and Y.Fujii.
THE ANNIHILATION OF ANTINUCLEON ACCORDING TO THE PREVIOUS THEORY. O.Hara and Y.Fujii.
Progr. theor. Phys., Vol. 17, No. 6, 819-20, 820-2, 822-3 (June, 1957).

Assuming that the pion—nucleon interaction is invariant under rotations in two charge spaces I and K, it is shown that the part responsible for the creation and annihilation of nucleon pairs cannot be local. The sign of the nucleon—antinucleon potential due to exchange of an odd number of pions is opposite to that found on the usual theory. An easier check, based mainly on kinematics and selection rules, is to consider the possible products of nucleon—antinucleon annihilation, a rough estimate giving a much higher percentage of γ-rays than on the usual theory. W.A.Hepner

539.11

15251 MASS REVERSAL AND WEAK INTERACTIONS.

T.Ouchi.

Progr. theor. Phys., Vol. 20, No. 6, 909-19 (Dec., 1958).

It is shown that the special mass reversal MR(1) and MR(2) can be applied to both the weak Fermi type interaction and the weak Yukawa type interaction without any internal contradiction in the theory of MR(4) and MR(3) (for strong interactions). The selection rules obtained are consistent with experiment and suggest taking the universal Fermi interactions with V—A coupling as the primary interactions for all the lepton processes. The mass reversibility of the theory under MR(1) requires that the space parity is not conserved in all the weak interactions and that the mass of the neutrino must be exactly zero. MR(2) invariance allows only a linear combination of (AV) couplings when the coupling is independent of the explicit masses. It is assumed that leptons are conserved and are C or D type fields under mass reversal, guaranteeing the conservation of baryons automatically. From the requirement of MR(4) and the consistency of the theory, the neutrino is shown to be a mass parity doublet. It is shown from the application of mass reversal to the lowest order diagrams in g that the unwanted lepton processes are forbidden or explained even when μ^-, e^- and ν are taken as the particles. The prediction of the rarity of $\pi \rightarrow e + \nu$, $\pi \rightarrow e + \nu + \gamma$ and $K \rightarrow e + \nu$ is given by extending the universal interaction proposed by Huang and Low in such a way that it is invariant under mass reversal. If this is true, the neutrino must have four components in a strict sense, and in the usual experiments is observed as if it were a two component field. If MR(3) is assumed to be applied even to Fermi interactions, MR(3) requires uniquely that the universal interactions have V—A coupling, and the helicity of the neutrino is -1. The decays $K \rightarrow (\pi) + \bar{\nu} + \nu'$ are shown to be ruled out by the mass parity conjugation invariance and MR(1), provided the leptons are C or D type fields under mass reversal. The mass parity is shown to be related closely to the strangeness which is the important difference between the present theory and Sakurai's one.

539.11

15252 IMPLICATIONS OF THE INTERMEDIATE BOSON BASIS OF THE WEAK INTERACTIONS: EXISTENCE OF A QUARTET OF INTERMEDIATE BOSONS AND THEIR DUAL ISOTOPIC SPIN TRANSFORMATION PROPERTIES.

T.D.Lee and C.N.Yang.

Phys. Rev., Vol. 119, No. 4, 1410-19 (Aug. 15, 1960).

Assuming that all weak interactions are transmitted through an intermediate boson field W, it is shown that the observed $|\Delta I| = \frac{1}{2}$ rule and the small observed mass difference between K_1 and K_2 lead to the conclusion that there exist four W particles: $W^{\pm}$, W^0 and $\bar{W}^0$. Furthermore, a natural assignment of the isotopic spin transformation property of these W particles follows a dual scheme in which the W's behave sometimes as $I = \frac{1}{2}$ and sometimes as $I = 1$ particles. Various experimental implications are discussed, including neutrino capture experiments, strong collisions exhibiting apparent nonconservation of strangeness, and strong collisions with apparent lepton production.

539.11

15253 ON THE ANALOGY BETWEEN STRONG INTERACTION AND ELECTROMAGNETIC INTERACTION.

Y.Fujii.

Progr. theor. Phys., Vol. 21, No. 2, 232-40 (Feb., 1959).

According to Sakata's composite hypothesis of heavy particles (Abstr. 6884 of 1957), it is assumed that the fundamental particles do not change their kind through strong interactions. A formulation of these interactions is given by requiring invariance under gauge transformations of the first kind applied to each baryon field. If one assumes that the phase function depends on the space-time coordinate, it leads to the existence of a neutral vector meson analogous to the electromagnetic field, the mass of which need not always vanish. Its consequences are examined and found to be quite favourable for the interpretation of the strong interaction. In particular, it leads to the conservation law of parity in strong interactions and the condition for the existence of the composite state.

539.11

15254 SOME APPLICATIONS OF THE GENERALISED UNITARITY RELATION.

R.E.Cutkosky.

Phys. Rev. Letters, Vol. 4, No. 12, 624-6 (July 15, 1960).

Summarizes results obtained for the discontinuities in crossing branch lines associated with anomalous thresholds in perturbation theory amplitudes. These results are applied to the processes $\pi + \pi \rightarrow \Sigma + \Sigma$, $\gamma + D \rightarrow D$ and to the calculation of the Mandelstam spectral functions in nucleon—nucleon scattering. E.J.Squi

539

15255 A POSSIBLE SYMMETRY IN SAKATA'S COMPOSITE MODEL.

S.Ogawa.

Progr. theor. Phys., Vol. 21, No. 1, 209-11 (Jan., 1959).

In this model n, p and Λ are the basic particles. The author proposes to neglect mass differences and consider the three on a equal footing. Similar couplings between each pair are then expe requiring two new triplets of mesons. Four of these are identifie with K-mesons. The other two are discussed in connection with t often suggested charge singlet pion. D.W.L.Spr

539

15256 ON A POSSIBLE RELATION BETWEEN SPACE AND ISO-SPACE.

J.Rayski.

Acta phys. Polon., Vol. 17, No. 2-3, 137-51 (1958).

Conservation of the third component of iso-momentum (angular momentum in the space of isotopic spin) can be secured even for weak interactions at the cost of assuming a composite structu of particles in isospace (two independent isospins I and K). Particles may be classified according to quantum numbers b, K^2, K_3, I_3 where b is the baryon number. This classification enables or to arrange particles into a table exhibiting interesting regularitie Rest masses are explicable in terms of the above quantum numbe There exists a fine structure and a hyperfine structure of the mas levels described by I^2 and I_3. Anomalous behaviour of the spin K (two orientations only) suggests isospace to be a euclidean subspa of a ps-euclidean space. It is suggested to combine isospace wit ordinary space into a more-dimensional ps-euclidean space. Th the anomalous behaviour of the spin K may be interpreted in term of a Zitterbewegung. Assuming a 6 or 12-dimensional space it is easy to understand why the pion is pseudoscalar.

539.

15257 FUSION OF PARTICLES IN FUNCTIONAL THEORY.

F.Destouches-Aeschlimann.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3593-5 (May 30, 1960). In French.

The study of a system of two particles with spin in relativistic functional theory. In certain cases such a system has states with constant relative wave-function. Two particles of spin $\frac{1}{2}$ thus form a composite system behaving like a particle of spin one. This gives a formal justification to the physical process of fusion. R.F.Peier

539.1

15258 FUSION IN FUNCTIONAL THEORY.

J.L.Destouches.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3596-8 (May 30, 1960). In French.

The definition of a "composite" part of a system of particles. A discussion of the properties of wave-functions of composite part and the form of the equations. R.F.Peierl

539.1

15259 POSSIBLE FORM OF THE RELATIVISTIC WAVE FUNCTIONS ASSOCIATED WITH THE MOTION AND STRUCTURE OF ELEMENTARY PARTICLES, AT THE NUCLEAR LEVEL.

P.Hillion and J.P.Vigier.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4295-7 (June 27, 1960). In French.

The form of the wave function in the authors' theory of elementary particles is discussed. It must have the transformation properties appropriate to both the external motion and the internal structure of a given particle. R.J.N.Phillip

539.1

15260 ON A MATHEMATICAL PROBLEM CONNECTED WITH THE THEORY OF LONGITUDINALLY POLARIZED PARTICLES.

M.S.Livshits.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 4, 797-800 (April 1, 1960). In Russian.

The energy operator of an electron can be represented in term of longitudinally polarized spinors, similar to those used in the theory of neutrinos. The author uses such Hamiltonians, previously introduced by Al'perin (Dokl. Akad. Nauk SSSR, Vol. 125, No. 6, 1183, 1959), derives their eigenvalues, corresponding current vectors and extends them to a pair of particles. J.K.Skwirzynsk

539.11

15261 CERTAIN TYPES OF NON-LINEAR WAVE EQUATIONS WHICH GENERALIZE THE EQUATIONS OF THE THEORY PARTICLES WITH SPIN. G.Petiau.
J hys. Radium, Vol. 20, No. 10, 784-96 (Oct., 1959). In French.

The general formalism of a theory of particles with spin is given re these are specified by spinorial functions which are solutions systems of non-linear partial differential wave-equations of the t order. The plane wave solutions of these equations are elliptical hyperelliptical functions of a given type. Examples and complete utions are given of nonlinear equations for unified fields of spin nd ħ or 0 and ħ/2.

539.11

15262 A SURVEY OF RELATIVISTIC TRANSFORMATIONS. M.F.Kaplon and T.Yamanouchi.
ovo Cimento, Vol. 15, No. 4, 519-36 (Feb.16, 1960).

The usefulness of invariance properties in calculating various ematical quantities relevant to particle physics is outlined and amples given. General formulae relating to the transformation distributions from one Lorentz system to another are given and ir uses demonstrated. Particular application is made to the ray distribution arising from π^0-decay.

539.11

15263 A GENERALIZATION OF THE FOLDY—WOUTHUYSEN TRANSFORMATION. G.Morpurgo.
ovo Cimento, Vol. 15, No. 4, 624-40 (Feb. 16, 1960).

A method for constructing a unitary operator which transforms e Hamiltonian of a Dirac electron in the presence of an electric ld into an even Hamiltonian is proposed and discussed. The transrmation function and the transformed Hamiltonian are expressed rough an operator G which satisfies an operator; when the electric ld is absent (free particle) the Foldy—Wouthuysen transformation re-derived; when the electric field is present and the equation r G is solved in series of m^{-1} the Pauli, Darwin, Foldy, Wouthuysen n-relativistic Hamiltonian is re-obtained; but in addition a method solution is now possible which converges rapidly and is not stricted to the non-relativistic case; the expansion parameter in is method of solution is $(1/mc^2)(e\hbar/mc)E$ for an uniform electric eld and $Ze^2/\hbar c$ for a Coulomb potential. Though the treatment in is paper considers in detail only the case of an electrostatic tential, the inclusion of any other term in the Hamiltonian is easy d, in particular, a magnetic field may be trivially included.

539.11

15264 WEAK GLOBAL SYMMETRY. S.B.Treiman.
uovo Cimento, Vol. 15, No. 6, 916-24 (March 16, 1960).

The Feynman, Gell-Mann model of weak interactions is odified by the introduction of neutral "currents", both of the trangeness preserving (J) and strangeness changing (S) variety. he various currents, neutral and charged, are chosen and coupled n such a manner as to guarantee the $|\Delta T| = \frac{1}{2}$ selection rule. The currents, charged and neutral, are taken together to form an isoopic vector. The charged S currents are taken to satisfy $S/\Delta Q = +1$. These conditions automatically impose on the S urrents the property that they transform like the components of n isotopic spinor. The arbitrariness in the currents which remains t this stage is now removed by a definite choice, patterned after nd meant to exploit Gell-Mann's model of global symmetry for trong baryon—pion interactions. In so far as the latter constitutes useful first approximation to strong interaction physics, one can nake certain fairly definite and verifiable predictions concerning eptonic decay of hyperons, and notably: the protons in $\Sigma^+ \to p + \pi^0$ lecay should be polarized in an opposite sense from those produced n $\Lambda^0 \to p + \pi^-$ decay; and Ξ and Λ decays should show the same olarization properties. Presently known properties of Σ, Λ, and Ξ lecays are well correlated in the present model.

539.11

15265 A TECHNIQUE FOR ELIMINATING THE VARIATION OF MASS WITH VELOCITY IN RELATIVISTIC PROBLEMS. S.Tyagaraja Rao.
Nuovo Cimento, Vol. 16, No. 2, 274-82 (April 16, 1960).

The solution of problems involving the relativistic change of mass with velocity is facilitated by the introduction of a new temporal arameter τ. When this parameter is used instead of t, the effecive mass of the particle becomes a constant. The equation of motion of a relativistic particle in a given e.m. field is obtained using this formulation. This leads to a simple derivation of Sommereld's fine-structure formula, correct up to second order in α.

539.11

15266 ONE-PARTICLE SINGULARITIES OF GREEN'S FUNCTIONS IN QUANTUM FIELD THEORY. II. W.Zimmermann.
Nuovo Cimento, Vol. 16, No. 4, 690-704 (May 16, 1960).

For Pt I, see Abstr. 11826 of 1959. The time ordered Green's functions are expanded with respect to the singularities arising from intermediate one-particle states.

539.11

15267 ON PAULI'S TRANSFORMATION. J.M.Jauch.
Nuovo Cimento, Vol. 16, No. 6, 1068-72 (June 16, 1960).

It is shown that Pauli's transformation (Abstr. 8397 of 1957) which mixes particle with antiparticle states is canonical but not unitary. It leads from one representation of the field operators to a new inequivalent one.

539.11

15268 ON THE PAULI GROUP. D.Lurié.
Physica, Vol. 25, No. 11, 1139-41 (Nov., 1959).

An eight-dimensional generalization of Wouthuysen's six-dimensional scheme for fermions is seen to result if use is made of the three-parameter Pauli group.

539.11

15269 THE DIRAC EQUATION FOR MANY-ELECTRON SYSTEMS. K.S.Viswanathan.
Proc. Indian Acad. Sci. A, Vol. 52, No. 1, 35-45 (July, 1960).

It is shown that the Dirac equation for an electron moving in a field can be derived by expressing the magnitude of the momentum four-vector in terms of its components. By considering a four-vector whose components denote the total momentum and energy of the particles, a relativistic equation for a system of several electrons has been derived. A representation of this equation has been made in the product space of the electrons and it is shown that for the special case of a system containing two electrons, it leads to the well-known Breit equation.

539.11

15270 THE CLEBSCH—GORDAN COEFFICIENTS. S.D.Majumdar.
Progr. theor. Phys., Vol. 20, No. 6, 798-803 (Dec., 1958).

A simpler method of deriving the Clebsch—Gordon coefficients is described. By the use of new operators for angular momentum, the problem, which properly belongs to the domain of algebra, is tackled by the more convenient methods of analysis. The natural occurrence of the hypergeometric function is an interesting feature of this treatment.

539.11

15271 A THEORY OF CLOTHED UNSTABLE PARTICLES. II. N.Nakanishi.
Progr. theor. Phys., Vol. 20. No. 6, 822-34 (Dec., 1958).

For Pt I, see Abstr. 12846 of 1960. The physical state of unstable particles previously proposed is derived as the state produced in a finite time interval on the basis of the scattering theory of Gell-Mann and Goldberger (1953), and also the exact state is obtained from the physical state by employing an appropriate limiting process. An S-matrix-theoretical calculation method is proposed for the processes including unstable particles.

539.11

15272 THEORY OF UNSTABLE PARTICLES IN THE WAVE-PACKET-FORMALISM. K.Yamamoto.
Progr. theor. Phys., Vol. 20, No. 6, 857-67 (Dec., 1958).

The scattering problem for finite time interval is discussed using the wave-packet formalism. A method is given for dealing with observations of different wave packets in an antinomic way. The unstable particle is investigated in connection with the transition probability in the frame of the wave-packet representation.

539.11

15273 ON THE UNSTABLE STATES IN QUANTUM FIELD THEORY. T.Gotō.
Progr. theor. Phys., Vol. 21, No. 1, 1-17 (Jan., 1959).

The unstable state in quantum field theory is investigated. Its properties are studied in detail by making use of Lee's model (Abstr. 9936 of 1954). The renormalization procedure is proposed and the corresponding Z-factor has values only between zero and unity. In the limit of g (the coupling constant) = 0, the Z-factor becomes unity in contrast to Naito's Z-factor (Abstr. 7286 of 1960) which becomes one-half.

539.11

15274 A NOTE ON THE PHYSICAL STATE OF UNSTABLE PARTICLES. N.Nakanishi.

Progr. theor. Phys., Vol. 21, No. 1, 216-17 (Jan., 1959).

The author indicates how to calculate the decay amplitude and carry out renormalization, expressing the clothed state in terms of the bare particle, and using the spectral function. D.W.L.Sprung

539.11

15275 SPIN--ORBIT FORCE AND A NEUTRAL VECTOR MESON. J.J.Sakurai.

Phys. Rev., Vol. 119, No. 5, 1784-5 (Sept. 1, 1960).

The coefficient of $(\sigma_1 + \sigma_2).\hat{n}$ in the pp scattering amplitude at 310 MeV can be completely accounted for by a strongly interacting neutral vector meson (or a sharp three-pion resonance in the $T = 0$, $J = 1$ state) of mass $\cong 3\mu_\pi - 4\mu_\pi$.

539.11

15276 THEORY OF LOW-ENERGY SCATTERING IN FIELD THEORY. M.Cini and S.Fubini.

Ann. Phys. (New York), Vol. 10, No. 3, 352-89 (July, 1960).

An approximate representation for the scattering amplitude of processes with two final particles, expected to be valid below the threshold for anelastic production of new particles, is deduced from the Mandelstam double integral representation. The principle underlying this reduction is that only the contributions from the singularities of the scattering amplitude near the physically interesting range of the variables need to be taken correctly into account, while the contributions from distant singularities can be expressed in the form of polynomial expansions. This means that anelastic processes are neglected in the unitary condition of the S matrix, and their effects lumped into arbitrary constants. The method leads to systems of coupled nonlinear integral equations for the lowest angular momentum partial waves of the different reactions described by the same amplitude. These equations coincide, for the problem of pion—pion scattering, with those found by Chew and Mandelstam with a different procedure. Meson—nucleon and nucleon—nucleon scattering are then investigated by means of a model in which all particles are neutral and spinless. In the first problem one obtains a generalization of the equations found by means of fixed momentum transfer dispersion relations, in which the effect of a possible strong pion—pion interaction is included. For nucleon—nucleon scattering the contribution of the two meson exchange to the scattering amplitude is expressed in terms of pion—pion and pion—nucleon amplitudes. This should be sufficient for the determination of most of the nucleon—nucleon phaseshifts, apart possibly from a few parameters (scattering lengths and effective ranges) of the lowest ones which depend critically on the higher mass states. The possibility of constructing a two-meson exchange static potential is also demonstrated.

539.11

15277 "ILLUSORY" STATES AND THE CONDITION FOR CROSSING SYMMETRY. V.D.Kukin and A.R.Frenkin.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 49-51 (July 1, 1960).
In Russian.

Mandelstam (Abstr. 4941 of 1951) showed that "illusory" states occur due to neglecting conditions for crossing symmetry. A model is constructed, with a fictitious source (a nucleon interacting with a relativistic fermion), which has an exact solution, in spite of crossing symmetry, and at the same time has an "illusory" state when the renormalized coupling constant g^2 is sufficiently large. J.K.Skwirzynski

539.11

15278 "NON-PHYSICAL" STEPS IN THE PERTURBATION THEORY. O.I.Zav'yalov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 64-7 (July 1, 1960).
In Russian.

Appearance of a continuous energy spectrum in a system of elementary reacting particles can be considered as due to the presence of "non-physical" or anomalous steps between intermediate states of the system. Necessary conditions for the presence of these anomalous steps in a generally complicated system of particles are formulated and proved. J.K.Skwirzynski

539.11

15279 SOME TOPICS IN COULOMB SCATTERING. B.Nagel.

K. Tekn. Högsk. Handl., No. 157, 30 pp. (1960).

A generalization of the Born approximation, using three-dimensional Coulomb wave-functions as unperturbed solutions, is applied to a study of various Coulomb scattering problems, includ the influence of vacuum polarization on proton—proton scattering, and relativistic Coulomb scattering of Klein—Gordon and Dirac particles.

539

15280 SOME RIGOROUS ANALYTIC PROPERTIES OF TRANSITION AMPLITUDES. S.Mandelstam.

Nuovo Cimento, Vol. 15, No. 4, 658-85 (Feb. 16, 1960).

The causality and mass-spectral conditions are used to deriv analytic properties of two-particle transition amplitudes as functi of energy and momentum transfer. While the complete double-dispersion representation cannot be proved from these postulates alone, it is shown that, within a certain domain in the space of two complex variables, the only singularities are the expected poles a cuts along the real axis. This domain surrounds the low-energy physical region. The proof is restricted to the scattering of the lightest particles in the theory. As long as no attempt is made to find the largest possible domain, the calculations are not very diff cult. The domain of analyticity can then be extended by the unitar condition. The magnitude of the extension is not very large, but th new domain differs from the old in including part of the region in which the two-dimensional spectral functions are non-zero. The unitarity condition below the threshold for inelastic processes is used only; if such processes could also be treated and the unitarit condition used at higher energies, it seems possible that the doma could be extended arbitrarily far. In the present results, the boundary of the domain of analyticity is sufficiently far from the low-energy region to justify the analytic properties assumed in applications of the double-dispersion representation. Other result that can be proved are that partial-wave amplitudes are analytic functions of the energy in a certain region, that the determination of coupling constants by extrapolation in the angle is valid if the energy is not too high, and that ordinary dispersion relations are true over a slightly larger range of momentum transfer than had previously been established.

539.

15281 THE MULTIPLICITY OF THE INTERPOLATING FIEL IN A SINGLE CAUSAL S-MATRIX. H.J.Borchers.

Nuovo Cimento, Vol. 15, No. 5, 784-94 (March 1, 1960). In Germa

Local commutativity of different fields is shown to be a transitive property of fields. A criterion is derived which permits a decision to be made as to whether two local fields are interpolatin fields to the same S-matrix or not. It is shown that there exist more than one interpolating field to a given causal S-matrix.

539.1

15282 SINGLE PARTICLE SINGULARITIES IN SCATTERING AND PRODUCTION AMPLITUDES.

J.Gunson and J.G.Taylor.

Nuovo Cimento, Vol. 15, No. 5, 806-16 (March 1, 1960).

The conjecture that residues at poles in two particle scatterin amplitudes are correctly given by lowest order renormalized pertu bation theory is proved rigorously for certain important cases. Some of the processes considered have poles in the complex momentum transfer plane lying in otherwise analytic regions. This justifies the use of extrapolation procedures for determining coupling constants and parities for these processes.

539.1

15283 A TEST OF APPROXIMATION METHODS IN POTENTI SCATTERING. J.D.Bjorken and A.Goldberg.

Nuovo Cimento, Vol. 16, No. 3, 539-48 (May 1, 1960).

Various approximation procedures in field theory for computin scattering amplitudes are tested on a soluble problem in potential theory — the s-wave scattering by an exponential potential. The methods include: (1) the Fredholm, or determinantal, expansion; (2) the Chew—Mandelstam procedure of constructing the scattering amplitude T_0 from analyticity properties and unitarity; (3) expansio of T_0 in powers of the potential strength λ (Born approximation); (4) expansion of tg δ_0 in powers of λ, and (5) expansion of ctg δ_0 in powers of λ. Each is carried out in first and second order of approximation and compared with the exact result. The results are displayed in effective-range plots of k ctg δ_0 versus energy. In addition, the energies of bound states as predicted by the approxima tions are compared with the exact result. Approximations (1), (2), and (5) in second order are comparable in accuracy, agree reasona well with the exact result, and are appreciably better than (3) and (4). The binding energy of the first bound state is predicted well by hod (2) in second order, and at best qualitatively by the other hods. All methods except (1) predict existence of bound states for lsive potentials.. In second order method (1) predicts no bound e for any value of λ.

539.11

.5284 THE INELASTIC SCATTERING OF ELEMENTARY PARTICLES. II.

eldman, P.T.Matthews and A.Salam.

vo Cimento, Vol. 16, No. 3, 549-55 (May 1, 1960).

For Pt I, see Abstr. 11838 of 1959. An approximate scheme for culating the inelastic scattering of elementary particles is pro- ed. The scheme fully incorporates the requirements of unitarity a partially includes causality. When applied to the simple prob- ls of $\pi-p$ and $\pi-\pi$ scattering, it reproduces very simply some l-known results.

539.11

15285 SOME REMARKS ON THE VERTEX FUNCTION.

A.Minguzzi and R.F.Streater.

ys. Rev., Vol. 119, No. 3, 1127-8 (Aug. 1, 1960).

It is noted that the integral representations for matrix elements ived in three papers, (1) Dyson (Abstr. 1047 of 1959), (2) Deser, bert, and Sudarshan (Abstr. 13018 of 1959) and (3) Fainberg str. 9253 of 1960) do not give the most general functions satis- ng the conditions stated. It is shown that in (1) and (2) the conver- ice of certain integrals was not treated rigorously, while in (3) re was a misunderstanding of the Jost—Lehmann—Dyson repre- tation.

539.11

15286 APPROXIMATE RELATIVISTIC COULOMB SCATTERING WAVE FUNCTION.

W.R.Johnson and C.J.Mullin.

ys. Rev., Vol. 119, No. 4, 1270-3 (Aug. 15, 1960).

A relativistic scattering wave-function, which is valid to second der in αZ for all electron velocities, is developed. The wave- ction has as its dominant term the Sommerfeld—Maue function. e computational simplicity of the closed form Sommerfeld—Maue ve-function is retained in this modified Sommerfeld—Maue func- n. Applications of the wave-function to the calculation of cross- ctions for the scattering of polarized electrons and bremsstrah- g production at the short wave limit of the spectrum are given. large first-order correction to the Sauter—Fano formula for e bremsstrahlung cross-section is obtained.

539.11

15287 THRESHOLD EFFECTS IN THREE-BODY CHANNELS.

L.Fonda and R.G.Newton.

ys. Rev., Vol. 119, No. 4, 1394-9 (Aug. 15, 1960).

For previous work, see Abstr. 8562, 11839, 13652 of 1959; 10 of 1960. The possibility of obtaining threshold anomalies in actions leading to three-particle channels is studied in detail. It found that a threshold cusp or rounded step exists in reactions ose final three-body channels have at least one particle in common. e effect appears as a function of the momentum of the common rticle while the total energy is fixed.

539.11

15288 FORMAL THEORY OF CLASSICAL SCATTERING.

P.Résibois.

hysica, Vol. 25, No. 8, 725-32 (Aug., 1959). In French.

An integral formalism is developed to study the two body- roblem, starting with the Liouville equation. It is shown that the scattering equations" take a very intuitive form when expressed the coordinate space and that the evolution of the velocity istribution function is closely related to the stationary solution of e Liouville equation with appropriate boundary conditions. The rmal analogy with the S matrix point of view in quantum mechanics stressed.

539.11

15289 ON A NEW FORM OF THE DISPERSION RELATIONS.

L.A.Khalfin.

okl. Akad. Nauk SSSR, Vol. 130, No. 2, 299-302 (Jan. 11, 1960). Russian.

New dispersion relations are developed, analogous to those of ilbert (Abstr. 7271 of 1958), but with the inclusion of certain pplementary conditions which must be satisfied by the amplitudes. he relations are derived from a theorem of Keldysh and Sedov, and eir advantages in enabling the maximum use to be made of perimental data are discussed. R.F.Peierls

539.11

15290 THE PROBLEM OF PROVING DOUBLE DISPERSION RELATIONS.

A.V.Astakhov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 307-10 (July 11, 1960). In Russian.

The Mandelstam representation is proved in fourth-order perturbation theory for the case of two interacting scalar boson fields, by using Dyson's integral representation of causal commutators and ordinary dispersion relations. D.W.L.Sprung

539.11

15291 BOUND STATES AND DISPERSION RELATIONS.

R.Blankenbecler and L.F.Cook, Jr.

Phys. Rev., Vol. 119, No. 5, 1745-52 (Sept. 1, 1960).

A vertex closely related to the Bethe—Salpeter amplitude is discussed in the one-meson exchange approximation by dispersion theory methods. Both scalar and spinor cases are treated. The relation between anomalous thresholds and the Schrödinger equation is discussed in some detail. It is shown that dispersion methods can be used to determine bound state parameters. An estimate is made of the asymptotic (D—S) ratio for the deuteron.

539.11

15292 DISPERSION RELATIONS AND VERTEX PROPERTIES IN PERTURBATION THEORY.

K.Symanzik.

Progr. theor. Phys., Vol. 20 No. 5, 690-702 (Nov., 1958).

Dispersion relations for nucleon—nucleon scattering with momentum transfer $2\,|\Delta| < \mu$, for meson—nucleon scattering and related properties of the meson—nucleon vertex, are shown to hold in every order perturbation theory. This is done by extending a method used by Nambu (Abstr. 872 of 1958) to discuss the perturbation-theoretical parametric representations of Green's functions. In effect arbitrarily complicated Feynman diagrams are reduced to a few simple types.

539.11

15293 APPLICATION OF DISPERSION RELATIONS TO NUCLEON—NUCLEON SCATTERING: THE TWO-PION CONTRIBUTION.

M.L.Goldberger and R.Oehme.

Ann. Phys. (New York), Vol. 10, No. 2, 153-70 (June, 1960).

The two-pion contribution to the amplitude for nucleon—nucleon scattering is computed in terms of the invariant amplitudes which characterize the four-body Green's function of the pion nucleon system. The dependence of this contribution upon the momentum transfer of the two-nucleon system is completely exhibited. A general method is described for the derivation of symmetry properties for the invariant coefficients in the expansion of the scattering amplitude in spinor space.

539.11

15294 ON THE VALIDITY OF DISPERSION RELATIONS IN PERTURBATION THEORY.

N.Nakanishi.

Progr. theor. Phys., Vol. 21, No. 1, 135-50 (Jan., 1959).

The dispersion relations with the ordinary threshold energies are proved in every order of perturbation expansion for $\pi-\pi$, $\pi-K$, $\pi-N$, $\pi-\Lambda$, $\pi-\Xi$, K—K, N—N, $\Lambda-\Lambda$, $N-\Xi$, K—N, $K-\Lambda$ forward scatterings. A counter-example is presented for $N-\Lambda$, $N-\Sigma$, $\Sigma-\Sigma$, $\Lambda-\Xi$, $\Sigma-\Xi$ scatterings. Non-forward scatterings also are treated.

539.11

15295 ANALYTIC STRUCTURE OF COLLISION AMPLITUDES IN PERTURBATION THEORY.

R.J.Eden.

Phys. Rev., Vol. 119, No. 5, 1763-83 (Sept. 1, 1960).

Some methods are developed for studying the singularities of collision amplitudes in perturbation theory as functions of two of the invariant energies, s, t, and u. It is shown that: (a) there are no singularities other than normal thresholds in the physical regions of the physical sheet; (b) for the equal-mass case there are no singularities in the Euclidean region of the physical sheet; (c) the only straight lines of singularities on the real boundary of the physical sheet are normal singularities in the equal-mass case, and in the general-mass case are either normal singularities or they intersect the Euclidean region; (d) the curves of singularities on the real s, t plane in the physical sheet do not connect to surfaces extending into the region s real, t complex except at turning points of the curves; (e) turning points of curves of singularities in the physical sheet may occur either when sufficient coincident singularities become also end-point singularities, or when there is an accidental relation between the Feynman variables at coincident singularities. The former correspond to anomalous thresholds; the latter are called spurious turning points; (f) for the equal-mass case there are no anomalous thresholds and no anomalous turning points in the curves of singularities; (g) spurious turning points do occur in negative spectral regions, but here it appears that they may not lead to complex singularities on the physical sheet. There are no spurious turning points in positive spectral regions in low orders in perturbation theory and to all orders for some types of diagram. It is plausible that there are none for any diagram, but this is not proved. The relation of this work to the Mandelstam representations (Abstr. 4941 of 1959; 1256-7 of 1960) is discussed. All the results proved in this paper are consistent with this representation. Some points are noted which require further investigation before the validity of the representation can be established to all orders in perturbation theory.

539.11

15296 SPIN—ORBIT POTENTIAL WITH PION SCATTERING CORRECTION. S.Okubo and S.Sato.

Progr. theor. Phys., Vol. 21, No. 3, 383-8 (March, 1959).

A dispersion relation is applied to the pion theory of spin—orbit potential.

539.11

15297 ON THE PHASE OF THE SCATTERED WAVE (A REPLY TO V.V.Malyarov). F.S.Los'.

Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1174-5 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 836 (April, 1960).

A reply to criticism of a previous note. See Abstr. 1817 (1958) and 2498 (1960). R.J.N.Phillips

539.11

15298 ON THE QUESTION OF DIRECT CONSTRUCTION OF THE ELASTIC SCATTERING AMPLITUDE.

G.I.Kopÿlov and Z.D.Lomakina.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1649-51 (May, 1960). In Russian.

By considering the equations resulting from the application of the unitary condition, an iterative procedure is developed for constructing directly the real and imaginary parts of the amplitude for the elastic scattering of spinless particles from a force centre, without resorting to a phase-shift analysis. Some numerical illustrations of the method are given. R.F.Peierls

539.11 : 539.12

15299 SOME ASPECTS OF PARTICLE MIXTURE OF STRANGE PARTICLES. S.Okubo.

Nuovo Cimento, Vol. 16, No. 5, 963-5 (June 1, 1960).

Combinations of weak and strong couplings lead to effective two-field terms in the Hamiltonian (e.g. giving direct $N \leftrightarrow \Lambda$ transitions), and hence to "particle mixture" effects. When such terms are removed by redefining the fields, certain direct decay interactions (e.g. $\Lambda N \pi$) appear; these are discussed. R.J.N.Phillips

539.11

15300 ASYMPTOTIC CONDITIONS AND PERTURBATION THEORY. K.Nishijima.

Phys. Rev., Vol. 119, No. 1, 485-98 (July 1, 1960).

The formulation of field theories based on few postulates but not using Lagrangian, Hamiltonian, or field equations has been investigated by many authors. In such a theory the coupled integral equations for Green's functions play the role of a substitute for field equations and serve to determine various physical quantities from the theory. Here a general prescription is given for the systematic solution of the coupled integral equations in perturbation theory. Two kinds of Green's functions are discussed: (a) the retarded functions, and (b) the time-ordered functions. Especially in the solution of the latter, dispersion relations have to be used, and one finds a complete correspondence between the numbers of subtractions in the dispersion relations and the types of interaction in the conventional field theory; furthermore, the so-called renormalized coupling constants can be introduced into this theory through the boundary conditions supplementing the subtracted dispersion relations. On the other hand, however, it is not possible even to define the unrenormalized coupling constants in this scheme. In other words, all unobservable divergent quantities are completely eliminated in this formulation, and no divergences occur in the course of the entire calculations. This method is applied to quantum electrodynamics to illustrate the above statement and also to show how one can get convergent unambiguous solutions in agreement with the conventional renormalized quantum electrodynamics. In discussing quantum electrodynamics, it is necessary to discover how to express the requirement of gauge invariance without referring to Lagrangian, Hamiltonian, or field equations; it is found th a set of equations which is a straightforward generalization of the Ward identity meets this requirement.

539.

15301 ABNORMAL BEHAVIOUR OF THE DILUTE FERMI G FOR NEGATIVE TWO BODY SCATTERING LENGTH.

L.van Hove.

Physica, Vol. 25, No. 9, 849-58 (Sept., 1959).

On the basis of an explicit formula for the two-body scatterin matrix,the conditions of applicability of the linked cluster expansi method to the ground state of a dilute Fermi gas with forces are studied in terms of the singlet scattering length of the two-body potential.

539.

15302 A METHOD OF CONSTRUCTING SPIN FUNCTIONS A GENERALIZED CHARACTER OPERATORS [IN MANY-PARTICLE SYSTEMS]. H.Narumi.

Doshisha engng Rev., Vol. 10, No. 2, 49-54 (Sept., 1959). In Japane

Treats a system which includes identical particles, each havin a certain higher spin. The generalization of the Dirac character operator in an electron system to higher spin systems is formulat branching diagrams are shown in the case of a spin-1 $\hbar$ system.

539.1

15303 COLLECTIVE MOTION AND PARTICLE EXCITATION IN MANY FERMION SYSTEM. S.Takagi.

Progr. theor. Phys., Vol. 21, No. 1, 174-84 (Jan., 1959).

A relation between collective motion and particle excitation in many-fermion system is investigated, and a method of constructing collective coordinates is presented. Preliminary application is ma to nuclear structure. Relations to other theories of collective moti are briefly discussed.

539.11 : 530.1

WIGNER DISTRIBUTION FUNCTION FOR SYSTEMS OF BOSO OR FERMIONS. See Abstr. 14533

539.1

15304 ON THE INTERNAL DEGREES OF FREEDOM OF PARTICLES IN QUANTUM FIELD THEORY.

I.Białynicki-Birula.

Acta phys. Polon., Vol. 17, No. 2-3, 153-76 (1958).

Definitions of the operators of the polarization and of the magnetic moment in quantum field theory are given. For the free fields these operators are the constants of motion. Their eigenvalues are investigated exactly for a spinor field. In the case of electrodynamics and mesodynamics, the time dependence of these operators is obtained for the interacting fields.

ELEMENTARY PARTICLES

539.12 : 537.54

15305 HIGH ENERGY PARTICLE RESEARCH WITH THE SYNCHROCYCLOTRON OF THE LABORATORY OF NUCLEAR PROBLEMS AT THE JOINT INSTITUTE OF NUCLEAR STUDIES. V.P.Dzhelepov and B.M.Pontecorvo.

J. nuclear Energy, Vol. 7, No. 1-2, 129-68 (Aug., 1958). English translation from: Atomnaya Energiya, Vol. 3, No. 11, 413 (1957).

A review of work from 1949 to 1957. The 5 m synchrocyclotron started operation in December 1949 accelerating deuterons to 280 MeV. At the end of 1950 the machine was modified to accelerat protons to 500 MeV. In 1953 the machine was rebuilt and the pole pieces of the magnet increased to 6 m resulting in the proton energy energy measuring to 680 MeV. The external proton beam is 0.5 μA, and at 15 m from the exit port of the accelerator the beam density is 1.5×10^9 protons $cm^{-2} sec^{-1}$. The experiments carrie out with the 5 m machine are first reviewed briefly. An account is given of experiments in elastic nucleon—nucleon scattering in the energy range 300-600 MeV. Results of proton—proton, neutron—neutron, proton—deuteron and exchange neutron—deuteron scatterin are summarized. These showed that at energies above 380 MeV there is a sharp increase in the meson production cross-section and that the total elastic nucleon—nucleon scattering cross-section for isotopic spin $T = 1$ states is constant while for $T = 0$ states it decreases with increasing energy. In addition many studies have been made of the interaction of mesons and nucleons. The total ss-section for π^+ and π^- mesons interacting with hydrogen and terium and the angular distribution of mesons scattered from lrogen were measured over the range 140-400 MeV. The results ifirmed the charge independence of these effects. Experiments the production of mesons by nucleons included measurements he energy dependance of the cross-sections, angular distribu- ns of the mesons and various measurements of the energy spectra particles emitted in inelastic collisions of two nucleons. From results of the experimental work it is concluded that (a) inter- ions between mesons and nucleons are charge independant and the meson—nucleon interaction is especially strong in the state h isotopic spin and angular momentum equal to 3/2. Other work luded investigations of μ-mesons and strange particles.

R.D.Smith

539.12

15306 SOME PREDICTIONS FROM A COMPOSITE MODEL OF BARYONS. D.H.Frisch.

ovo Cimento, Vol. 15, No. 5, 757-9 (March 1, 1960).

Baryons are considered as composites of a neutral baryon re plus various mesons. This model makes three specific edictions: (1) The $K^+-\Sigma^0(\Lambda^0)$ force should be much more attrac- e than the $K^--\Sigma^0(\Lambda^0)$ force. (2) Neutral particles should be proximately electrically neutral throughout. (3) At high energies ny elementary particle reactions should have characteristic gular distributions.

539.12

15307 NOTE ON POSSIBLE RARE DECAY MODES FOR ELEMENTARY PARTICLES.

.Galzenati, M.Marinaro and S.Okubo.

uovo Cimento, Vol. 15, No. 6, 934-6 (March 16, 1960).

Some of the bound-state decay processes of elementary par- cles, such as a neutron decaying into a hydrogen atom, are investi- ated. It is found that they may happen in a rate of one to a million, mpared to the usual modes.

539.12

15308 CHARGES.

P.Renson.

hysica, Vol. 25, No. 9, 809-24 (Sept., 1959). In French.

Properties of charges in general are discussed and it is shown at, whatever the nature of the charge considered, its value for y elementary particle can be deduced from the corresponding alues for a minimum number of such particles, namely 3. This ads to the introduction of a "charge-space" which, in the present tate of knowledge, is three-dimensional. Examples are given. The neutrinonic charge" which is to the neutrino what the electric harge is to the electron is especially studied. Correlations between harges and between charges and S and T_3 are discussed.

539.12

15309 MARKOFF CASCADES WITH GENERAL SOURCE TERMS. J.W.Gardner.

uovo Cimento, Vol. 16, No. 6, 977-90 (June 16, 1960).

The longitudinal development of the multiplicative cascade, onsidered as a generalized Markoff process, is presented for the ase in which the source is not necessarily a δ-function of space or nergy. Last collision diffusion equations are established and ormally solved, and practical applications are discussed. In ddition to its "traditional" application to cosmic radiation theory he Markoff cascade has important applications to the theory of uclear reactors.

539.12

15310 ANGULAR DISTRIBUTIONS.

E.Lubkin.

uovo Cimento, Vol. 16, No. 6, 1098-1108 (June 16, 1960).

The theorem for distributions in the angles θ, φ is extended to he third Euler angle, ψ, whereupon it becomes equivalent to the otational invariance of the responsible interactions. An inter- retation of half-angle terms in the general rate formula is given.

539.12

15311 ANALYSIS OF SYSTEMATIC ERRORS IN INVESTIGATIONS OF SMALL-ANGLE SCATTERING.

.G.Filippenko.

h. tekh. Fiz., Vol. 30, No. 1, 57-62 (Jan., 1960). In Russian.

A calculation of systematic errors introduced in deducing ifferential cross-sections from data obtained with detectors aving finite opening angles and sizes (e.g. counter telescopes). The divergence of the primary beams is also taken into account. Experimental checks of the results of these calculations have proved satisfactory.

G.Martelli

539.12

15312 MULTIPLE PRODUCTION OF NONSTABLE PARTICLES IN PION NUCLEON COLLISIONS.

V.S.Barashenkov and V.M.Maltsev.

Acta phys. Polon., Vol. 17, No. 2-3, 177-82 (1958)

The statistical theory of multiple production of pions, nucleons, unstable particles and antiparticles in (πN) collisions is considered by using the method previously described (Abstr. 5193, 6114 of 1958). The deductions from the theory can be made to agree with the experimental data if it is assumed that "strange" and "usual" particles are produced in different space volumes.

Photons

539.12 : 539.18

15313 COMPTON EFFECT ON THE BOUND ELECTRONS.

D.Brini, E.Fuschini, N.T.Grimellini and D.S.R.Murty.

Nuovo Cimento, Vol. 16, No. 4, 727-36 (May 16, 1960).

The behaviour of the Compton differential cross-section on the K-electrons of Pb was measured, using γ-rays of 664 keV energy. The angles investigated cover the range 10-85°. The behaviour is not very different from the behaviour corresponding to free electrons. The more significant aspect is the indication of a cross-section for the bound electrons greater than the cross-section for free electrons.

539.12 : 538.18

15314 COHERENT SCATTERING OF PHOTONS OF 2.62 MeV BY THE K-LEVEL ELECTRONS OF MERCURY.

H.Cornille and M.Chapdelaine.

Nuovo Cimento, Vol. 14, No. 6, 1386-90 (Dec. 16, 1959). In French.

Scattering cross-sections calculated on the Rayleigh and Thomson principles differ markedly from those obtained experimentally. Possible causes include scattering by L-electrons, nuclear resonance, and experimental error; these cannot account for the whole difference and it is therefore considered that the disrepancies are chiefly due to the Delbrück effect.

A.E.I.Research Laboratory

539.12

15315 A NOTE ON QUASI-ELASTIC PHOTON—DEUTERON SCATTERING. P.Federbush.

Nuovo Cimento, Vol. 15, No. 3, 479-80 (Feb. 1, 1960).

The problem of quasi-elastic photon—deuteron scattering is examined in the energy region sufficiently above the deuteron binding energy not to be limited to the deuteron Thomson cross-section but below the meson threshold where the calculation is relatively simple. Perturbation theory is used, allowing a single meson to be exchanged by the two nucleons as a correction to the usual impulse approximation where no mesons are exchanged. Preliminary results of γ-deuteron scattering in the energy range of 90 MeV seem to indicate deviations from the impulse approximation larger than that obtained by the present calculation.

J.D.Dowell

539.12

15316 EFFECTS OF COLLISIONS ON THE CYCLOTRON RADIATION FROM RELATIVISTIC PARTICLES.

L.Oster.

Phys. Rev., Vol. 119, No. 5, 1444-56 (Sept. 1, 1960).

The effects of collisions are investigated, supposing a uniform velocity for the particles. For the collision process it is assumed that the particles start to radiate at a certain time and are abruptly stopped by the collision, after which they start to radiate again with random phase. The probabilities for the occurrence of a certain time interval between two collisions are then assumed to be distributed according to a statistical law. The field equations are derived from the familiar Liénard—Wiechert potentials and Fourier-analysed. Simple integral representations are found for the combined spectral and angular distribution of the radiation. Under the basic assumption that the particles make many revolutions between two collisions, it is shown that the radiation pattern is that of a series of spectral lines, each having a dispersion profile. The relative intensities of the lines are given by the formula well known from previous work neglecting collisions. For the "slightly relativistic" energy range, $\beta_0 = 0.5 - 0.9$, of interest to thermofusion experiments, graphs are given for the actual intensity distribution of the various harmonics as a function of the angle between the observer and the orbital plane.

539.12

15317 MEASUREMENT OF THE POLARIZATION OF SYNCHROTRON RADIATION [OF ELECTRONS].

P.Joos.
Phys. Rev. Letters, Vol. 4, No. 11, 558-9 (June 1, 1960).

It has recently been calculated that the polarization of synchrotron radiation is elliptic with a ratio of major and minor axes depending on the angle Ψ between the direction of observation and the synchrotron plane (Bethe, unpublished). This paper reports an experimental confirmation of this prediction and a determination of the polarization as a function of Ψ, which is in good agreement with theory. Since, for example, the light of the Crab nebula is supposed to be due to high-energy electrons radiating in a magnetic field, these measurements have astrophysical importance. H.Motz

539.12

15318 ABSORPTION OF GAMMA-RADIATION IN MACRO-SYSTEMS FROM A POINT SOURCE.

A.Kh.Breger, B.I.Vainshtein, L.S.Guzei, Yu.S.Ryabukhin and N.P.Sy̆rkus.
Dokl. Akad. Nauk SSSR, Vol. 131, No. 6, 1308-11 (April 21, 1960). In Russian.

The energy transmitted and absorbed by a cylinder of material containing a radioactive point source is calculated. The amount of radiation leaving the surface of the absorbing body in the form of scattered radiation is also calculated for the case of cylindrical geometry. Experimental checks confirm the results of the calculation. G.Martelli

539.12

15319 INTERNAL PAIR ANGULAR CORRELATION SPECTROMETER FOR DETERMINATION OF γ-RAY MULTIPOLARITIES.

G.A.Bartholomew.
Canad. J. Phys. Vol. 38, No. 6, 871-7 (June, 1960).

The paper demonstrates the feasibility of measuring γ-ray multipolarities with a 180° flat field pair spectrometer, by determining the angular correlation between positrons and electrons produced by γ-ray internal pair conversion, this correlation being an index of the multipolarity of the γ-ray transition. At E_γ = 6 MeV and 1% energy resolution the theoretically calculated efficiencies are comparable to those obtained experimentally with the lens type internal pair spectrometer (Abstract 4447 of 1957). I.C.Demetsopoullos

539.12

15320 INSTRUMENTATION FOR MEDIUM ENERGY GAMMA-RAY SCATTERING MEASUREMENTS.

E.L.Garwin and A.S.Penfold.
Rev. sci. Instrum., Vol. 31, No. 8, 853-60 (Aug., 1960).

A system for the energy analysis of scattered γ rays of up to 70 MeV energy is described. A 5 in. diam, 4 in. long NaI(Tl) crystal was the energy sensitive element. The net amplification between the ten-stage photomultiplier output and the pulse-height analyser input was 1.8. The pulse-height-to-channel transfer characteristic of the system departs from linearity by less than 0.05 channel between the 50th and 16th channel and by one channel between the 16th and sixth. It is demonstrated that the light-to-voltage transfer characteristic of the photomultiplier is linear up to at least 30 V output levels. Provision for direct determination of the effect of superposed pulses (pileup) is incorporated into the system. Careful shaping of the pulses reduced pileup to a minimum, commensurate with obtaining good resolution from the NaI(Tl) crystal. Some typical pulse-height spectra are given, and the novel features of the circuits are described.

539.12

15321 NEUTRON-INSENSITIVE PROPORTIONAL COUNTER FOR GAMMA-RAY DOSIMETRY.

R.S.Caswell.
Rev. sci. Instrum., Vol. 31, No. 8, 869-71 (Aug., 1960).

A gamma-ray dosimeter with low sensitivity to neutrons has been developed for radiation dosimetry in mixed fields of neutrons and gamma rays. Neutron sensitivity in a 2.5 to 3 MeV $H^2(d,n)He^3$ neutron field has been shown experimentally to be ≤ 1.2% on the basis of first collision dose in tissue. Gamma-ray sensitivity is independent of energy to within ± 5% from 1.25 MeV (Co^{60}) to 200 keV and to within ± 20% down to 47 keV. The instrument is a proportional counter which may be used as a dosimeter for gamma rays in the presence of neutrons by pulse-height integration of the small pul due to secondary electrons produced by gamma rays and rejecti of the large pulses due to heavy particle recoils from neutrons.

539.12 : 53

15322 EFFECT OF NUCLEAR MAGNETIC MOMENT ON T BREMSSTRAHLUNG OF ELECTRONS.

S.Sarkar.
Nuovo Cimento, Vol. 15, No. 4, 686-90 (Feb. 16, 1960).

Electron—nucleus bremsstrahlung is treated by representin the nucleus as a static model having charge and magnetic momer the electromagnetic potentials of which have been given by Newtc (Abstr. 6703 of 1956). The cross-section is first derived for the case of targets with definite direction of the magnetic moment of the nuclei and then it is averaged over all such possible directio

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15323 INVESTIGATIONS OF BREMSSTRAHLUNG OF ELEC TRONS IN THE ENERGY INTERVAL 10^{11}—10^{12} eV.

J.Benisz, Z.Chyliński and W.Wolter.
Acta phys. Polon., Vol. 18, No. 2, 143-52 (1959).

Four high energy (about 10^{12} eV) electron—photon cascades were investigated at the first stage of their development. The nu ber and the energy of the electron pairs of the first generation, p duced on the first radiation length were estimated and compared with the theoretical values calculated on the basis of the theory o Bethe and Heitler. The same also were calculated according to t theories of Landau, Pomeranchuk and Ter-Mikaelyan, which take into account the influence of the medium on the bremsstrahlung o electrons of very high energy. The experimental results are in better agreement with the predictions of Landau, Pomeranchuk a Ter-Mikaelyan than with that of Bethe and Heitler. This fact confirms the results obtained earlier (Abstr. 267 of 1958).

539

15324 STUDY OF THE ENERGY LEAKAGE FROM A BEAM OF BREMSSTRAHLUNG RADIATION IN AN ABSORPTION CALORIMETER. I.

S.P.Kruglov and I.V.Lopatin.
Zh. tekh. Fiz., Vol. 30, No. 4, 424-32 (April, 1960). In Russian.

A collimated beam of bremsstrahlung radiation from an elec synchrotron (E_{max} = 85 MeV) fell on a lead absorber 12 cm long and 12 cm dia. Scattered and secondary radiation was measured various angles with a special ionization chamber. The necessary subsidiary experiments to determine the efficiency of this are described. Results are given in terms of the effective albedo of t lead block and represent a total energy loss of $1\frac{1}{2}$% at E_{max} = 85 Forming the lead block into a shape like a thick-walled Faraday cylinder gives the greatest possible reduction of energy loss. J.H.Frem

539

15325 BREMSSTRAHLUNG LINEAR POLARIZATION.

J.W.Motz and R.C.Placious.
Nuovo Cimento, Vol. 15, No. 4, 571-98 (Feb. 16, 1960).

Presents a general quantitative description of the bremsstrah linear polarization on the basis of original experimental data and available theoretical calculations. The results give the dependenc of the polarization on (a) the initial electron kinetic energy, T_0, in range from 10^{-2} to 10^3 Mev, (b) the photon energy in a range from 0.1 T_0 to T_0, (c) the photon emission angle in a range from 0 to 18 degrees, and (d) the atomic number of the target in a range from to 79. The experimental data were obtained for a range of electro energies from 0.05 to 1.0 MeV with beryllium, aluminium, and gol targets. Theoretical estimates of the polarization were calculatec from the Sommerfeld—Kirkpatrick—Wiedmann results for the non relativistic energy region, the Olsen—Maximon results for the extreme relativistic energy region, and the Gluckstern—Hull (Bor approximation) results for the intermediate energy region. Final results are expressed in terms of the peak polarization and the corresponding peak angle as a function of the electron and photon energies, and best estimates of the polarization are given on the basis of the combined experimental and theoretical data.

539.

15326 PRODUCTION OF BREMSSTRAHLUNG BY LONGITUDINALLY POLARIZED ELECTRON—PROTON COLLISIONS.

S.Sarkar.
Nuovo Cimento, Vol. 17, No. 2, 219-23 (July 16, 1960).

The author calculates the differential cross-section for the production of bremsstrahlung in high energy collisions of longitudinally polarized electrons and protons considering the effect of nomalous magnetic moment and the recoil of the proton. The ix element for the bremsstrahlung of the proton is neglected o the formula is valid when the angle between the directions e electron and the photon is of the order of mc/p (m and p the mass and momentum of the electron respectively).

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5327 A SOFT X-RAY SPECTROMETER USING A FLOW PROPORTIONAL COUNTER. J.E.Holliday.

sci. Instrum., Vol. 31, No. 8, 891-5 (Aug., 1960).

A soft X-ray spectrometer operating in the wavelength region)-200 A has been built in order to study the electronic properties etals and alloys. The detector is a flow proportional counter a 1000 A cellulose nitrate window. The window sets the upper t of the spectrometer and will transmit only 17% of the radiation 00 A. By using an aluminized replica grating of 600 lines/mm, esolution was calculated to be 0.7 A for a wavelength of 64 A. $M_{4,5}$ emission spectra of Mo and Nb, and the K emission bands and Be, have been investigated. The K emission band of Be a peak intensity of 475 counts/sec and a peak-to-background ratio 0 to one for a beam current of 4 mA and a potential of 1900 V. carbon K emission band had a peak intensity of 700 counts/sec a peak-to-background ratio of 30 to one for a beam current of A and a potential of 2000 V.

trinos

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.5328 NEUTRINOS EMITTED IN β-DECAY AND μ CAPTURE. S.P.Rosen.

s. Rev. Letters, Vol. 4, No. 12, 613-15 (June, 1960).

The possibility is explored that the neutrinos created in μ^- cap-e and β^+ decay have opposite helicities. This is not excluded by experimental facts of π and μ decay. It would mean rejecting the versality of V—A coupling, the two-component neutrino, and the ermediate vector boson. Also it would forbid the reaction $+ n \rightarrow p + e^-$ for neutrinos produced by π^- decay and the process $+ p \rightarrow e^- + p$. A.Ashmore

539.12 : 530.12

NEUTRINO AND GRAVITY. See Abstr. 14493

ctrons

539.12

15329 THE PROCESS $e^- + p \rightarrow \Lambda + \nu$. V.M.Shekhter.

. eksper. teor. Fiz., Vol. 38, No. 4, 1343-5 (April, 1960). Russian.

In view of the rarity of leptonic decays of hyperons, it is ggested that the above interaction might be studied. Expressions e given for the expected cross-sections according to the VA eory, and the total cross-section for incident electrons of 400 MeV found to be 0.35×10^{-40} cm^2. It is suggested that it might be ssible to observe this reaction and analogous ones. R.F.Peierls

539.12

15330 RADIATIVE CORRECTIONS TO ELECTRON—ELECTRON SCATTERING. G.Furlan and G.Peressutti.

ovo Cimento, Vol. 15, No. 5, 817-30 (March 1, 1960).

The e^6 corrections to the differential cross-section for Møller attering have been computed. The divergences for high values of the the momentum of the virtual photons have been removed by the ual techniques of renormalization. The infrared divergence has en eliminated by adding the cross-section for the bremsstrahlung ocess associated with Møller scattering. Numerical computa-ns gave reasonable results for the corrections.

539.12

15331 SCATTERING OF ELECTRONS BY PROTONS IN SECOND BORN APPROXIMATION AT INCIDENT NERGIES OF ABOUT 100 MeV. G.Meyer.

Naturforsch., Vol. 15a, No. 5-6, 548 (May-June, 1960). In German.

The correction is calculated, and exhibited as a function of angle for three energies, for a point proton. It becomes over 2% at backward angles. E.J.Squires

539.12

15332 CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN CARBON. L.B.Leder and J.A.Suddeth.

J. appl. Phys., Vol. 31, No. 8, 1422-6 (Aug., 1960).

The values reported for the characteristic energy losses of electrons in carbon vary by as much as 50%. In an attempt to resolve this disrepancy the electron energy losses have been re-measured for evaporated carbon and natural graphite, and it is found that there is a large difference for these two forms of carbon. Electron diffraction patterns of evaporated carbon show it to be highly amorphous. Annealing of the films causes growth of the crystallites, and also an increase of the energy loss toward the loss values for graphite. It is shown by calculation that the difference in the energy losses for the two forms is due to a difference in density, and that annealing increases the density of the evaporated carbon and, therefore, the energy loss value.

539.12

15333 MEASUREMENT OF ABSORPTION IN GRAPHITE OF ELECTRONS FROM MESON μ DECAY. W.Kusch.

Acta phys. Polon, Vol. 17, No. 5, 295-309 (1958).

The results of the measurements were compared with the absorption curves calculated by assuming a linear relation between the actual electron path and the energy, and relations that result from the inclusion of the radiation losses. In the calculations, the electron spectrum given by Michel ($\rho = 0.55$, W = 52.7 MeV) was assumed (Abstr. 5516 of 1950). Account was also taken of the increase in the path of the electrons as a result of scattering. Comparison of experimental and calculated results show that the mean total energy loss for electrons from the decay of μ-mesons is 1.92 MeV/(g cm^{-2}), whereas the mean energy loss due to ionization is (1.70 ∓ 0.15)MeV/(g cm^{-2}).

539.12

15334 PENETRATION OF ELECTRONS THROUGH A RECTANGULAR POTENTIAL BARRIER WITH A SMALL CYLINDRICAL INHOMOGENEITY. N.B.Aizenberg.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1178-85 (June, 1960). In Russian.

The "tunnel effect" penetration of electrons through a rectangular potential barrier is considered in the case where the height of the barrier is reduced over a small inhomogeneous region. Wave-mechanical theory is applied to the cases of narrow and wide inhomogeneities, and the effects on transmission are numerically deduced. Scattering occurs at the edge of the inhomogeneity. A.E.I.Research Laboratory

539.12

15335 MEASUREMENT OF THE DEGREE OF LONGITUDINAL POLARIZATION OF BETA PARTICLES. L.A.Mikaélyan and P.E.Spivak.

Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1168-70 (Oct., 1959). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 37(10), No. 4, 831-3 (April, 1960).

Experiments are described in which the degree of longitudinal polarization of β-particles from P^{32}, In^{114}, Lu^{177}, Sm^{153} and Ho^{166} has been measured. In this work, the longitudinal polarization was changed to transverse by passing the β-particles through crossed electric and magnetic fields. Subsequently, the particles were scattered by a thin gold foil and the polarization determined by measuring the left-to-right scattering asymmetry of particles scattered through 120°. Preliminary energy selection of the electrons was necessary, and the spectrum examined extended from 250 to 450 keV. Accuracy ~ 1% was achieved in the relative measurements. The results indicate appreciably different degrees of polarization for the different isotopes. An absolute value of 0.9 ± 4% was obtained for the longitudinal polarization of β-particles from Sm^{153}. R.E.Meads

539.12 : 539.2

15336 ANGULAR CORRELATION OF ANNIHILATION RADIATION IN SULFUR AND ITS COMPOUNDS. P.Colombino, I.Degregori, L.Mayrone, L.Trossi and S.DeBenedetti.

Phys. Rev., Vol. 119, No. 5, 1665-6 (Sept. 1, 1960).

The angular correlation between the γ-rays of positron annihilation in elemental sulphur and in several sulphur compounds was found to be practically the same in all samples studied. The observed correlation in similar to that observed with chlorine salts — a similarity that, in some cases at least, may be correlated to the similarity of the ions Cl^- and S^{2-}.

539.12 : 539.2

POSITRONIUM IN METALS. See Abstr. 15520

Nucleons

539.12

15337 AN INVESTIGATION OF THE STABILITY OF NUCLEONS. G.K.Backenstoss, H.Frauenfelder, B.D.Hyams, L.J.Koester, Jr and P.C.Marin.

Nuovo Cimento, Vol. 16, No. 4, 749-55 (May 16, 1960).

A search has been made for relativistic charged particles emitted by the decay of nucleons. No such events were detected, and according to postulates made about the decay mode, lower limits may be set on the nucleon lifetime. These vary between 1.5×10^{26} and 2.8×10^{26} years for nucleons in many-particle nuclei and between 2.2×10^{24} and 4.7×10^{24} years for protons in hydrogen.

539.12

15338 MULTIPLE OF HEAVY UNSTABLE PARTICLES IN EXTREMELY ENERGETIC NUCLEON—NUCLEON COLLISIONS. G.Domokos.

Acta phys. Hungar., Vol. 9, No. 1-2, 49-62 (1958).

Possible reaction schemes are established on the basis of Gell-Mann's theory. In order to apply the Fermi—Landau thermodynamical model to the production of heavy unstable particles, their interaction with pions is investigated. Some characteristic quantities of the two-proton system are calculated. The results seem not to contradict experimental results.

539.12

15339 EXCITED NUCLEON INTERPRETATION OF HIGH ENERGY NUCLEAR INTERACTIONS. F.J.M.Farley.

Nuovo Cimento, Vol. 16, No. 2, 209-26 (April 16, 1960).

An analysis of the kinematics of the excited nucleon model leads to three relationships which are found to be in fair agreement with the experimental data: (i) inelasticity-n_s relation; (ii) backward angle-n_s relation and (iii) forward angle—primary energy relation. A simple statistical treatment of the excited nucleon itself gives a good fit to the transverse momentum distribution in jets.

539.12

15340 ENERGY DEPENDENCE OF THE NUCLEON–NUCLEON PHASE SHIFTS. H.P.Noyes.

Phys. Rev., Vol. 119, No. 5, 1736-42 (Sept. 1, 1960).

Starting from the analytic structure of partial wave amplitudes predicted by the Mandelstam representation (Abstr. 4941 of 1959) relativistic formulae are derived for the energy dependence of the phase shifts for nucleon—nucleon scattering, neglecting inelastic processes. These formulae depend on integrals over functions defined by a (numerically) soluble integral equation whose kernel is determined from the absorptive part of the amplitude in the non-physical region. The contribution to this kernal from single pion exchange is explicitly exhibited and the contribution from two-pion exchange is calculable. A generalization of the formulae to include phenomenological constants representing the unknown contribution of multimeson and other particle exchanges is given. The dependence of the phase shifts on these parameters is sufficiently simple to allow the formulae to be used for the least-squares fitting of empirical data. Further, these constants can be varied independently, and as much empirical information as is desired can be incorporated into the formulae without destroying this independence. In the case of coupled states, the phenomenological formulae satisfy unitarity only approximately; this approximation can be removed by a subsidiary calculation, which destroys the independence of the parameters for these states. Because of the neglect of inelastic processes, the range of validity of the formulae is expected to be from 0 to ~400 MeV.

539.12

15341 THEORY OF LOW ENERGY NUCLEON—NUCLEON SCATTERING. I.

D.Amati, E.Leader and B.Vitale.

Nuovo Cimento, Vol. 17, No. 1, 68-97 (July 1, 1960).

The nucleon—nucleon interaction at energies below the threshold for inelastic processes, is studied using a method based on th
Cini—Fubini approach to the Double Integral Representation t
The essential idea is to treat all the singularities of the ampli
for values of the variables lying near their physical region, ta
full advantage of the symmetry of the Mandelstam representat
The spectral functions are calculated using unitarity, both in t
nucleon—nucleon and in the nucleon—antinucleon channels. In
latter the two pion contribution is calculated in terms of pion-
nucleon scattering and contains amplitudes characterising the
waves of the $N\bar{N} \rightarrow 2\pi$ process. The construction of integral e
tions for the partial wave amplitudes is discussed. The nucle
nucleon amplitude is developed in terms of linear combination
the Fermi operators chosen to have simple properties under c
and whose invariant coefficients are shown to satisfy a Mandel
representation in 4th order perturbation theory.

15342 POLARISATION OF NUCLEONS DUE TO ANOMAL
MAGNETIC MOMENT IN HIGHER BORN APPROX
MATION. S.Sarkar.

Indian J. Phys., Vol. 33, No. 5, 213-20 (May, 1959).

Schwinger's calculation (Abstr. 1669 of 1948) has been ext
to the second Born approximation taking a non-relativistic for
the interaction of spin orbit coupling. Considering the corresp
invariant interaction of the form $F_{\mu\nu} \gamma_\mu \gamma_\nu$ the expression for
polarization of the scattered particles in first order relativisti
Born approximation has been calculated. This result agrees w
Wolfenstein's expression except for the characteristic Couloml
phase factor. An attempt has been made (Abstr. 4980 of 1950)
calculate the corresponding second order relativistic Born app
mation.

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15343 ABSORPTION EFFECTS IN ANTINUCLEON
PHENOMENA. Y.Kakudo, T.Kammuri and R.Nakas

Progr. theor. Phys., Vol. 20, No. 2, 243-5 (Aug., 1958).

The effects of absorption in nuclear matter of the incident
final particles are estimated for; (a) antiproton production by
protons in carbon; (b) antineutron production by 440 MeV anti-
protons in carbon and lead. Satisfactory agreement with exper
ment is obtained for (a), but for (b) the estimated cross-sectior
are ~6 times too low.

A.Ash

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15344 ANTINUCLEON ANNIHILATION AND MULTIPLICI
OF EMITTED PIONS. Z.Koba.

Progr. theor. Phys., Vol. 19, No. 5, 594-5 (May, 1958).

In this preliminary note, a semi-quantitative relation betw
the large cross-section and the high multiplicity of emitted pio
nucleon—antinucleon annihilation experiments is deduced.

C.F.Ba

Protons

5.

15345 UPPER LIMIT FOR THE INTRINSIC ELECTRIC D
MOMENT OF THE PROTON AND THE NEUTRINO.
S.Rosendorff.

Nuovo Cimento, Vol. 17, No. 2, 251-8 (July 16, 1960).

The elastic scattering of electrons by a proton with an intri
electric dipole moment (e.d.m.) is calculated in first Born appr
mation. The cross-section is quite sensitive to the e.d.m. inter
action at high energies and large angles. It therefore seems lik
that high energy electron—proton scattering may give valuable i
mation on the value or upper limit of the proton e.d.m. coupling
strength. Certain spin correlation effects between the recoil pr
and the initial electron arising from the e.d.m. interaction are
discussed. In the last section the calculation of the ionization p
of a neutrino due to its intrinsic e.d.m. is briefly outlined and c
pared with the experimental results of Cowan and Reines.

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15346 INTERACTIONS OF 6.2 GeV PROTONS IN EMULSIO
I. GENERAL RESULTS.

H.Winzeler, B.Klaiber, W.Koch, M.Nikolić and M.Schneeberger.

Nuovo Cimento, Vol. 17, No. 1, 8-34 (July 1, 1960).

About 700 interactions were found by following 6.2 GeV prot
"along the track". An interactions mean free path of (38.2 ± 1.5

btained. 42 possible proton-free proton collisions were separ- and the cross-section for meson production was found to be mb. An average multiplicity for charged secondary tracks in stic p—p collisions of 2.8 ± 0.3 was found and the branching of 2 prong to 4 prong events was about 2. These values were ared with the predictions of the statistical theory and with a fication of it. The results of this investigation would be consist- ith a model which assumes that at these energies about 50% of llisions are "peripheral" ones which lead to (nucleon) isobar or N*N*) formation only. The angular distribution of all thin dary tracks in the L system have been measured and the la of Castagnoli et al. has been applied to a reasonably selected le of stars. This gave an overestimation by a factor of about the primary energy. Other investigators have obtained a ar value at 10^{12} eV.

539.12

5347 ELASTIC SCATTERING AND POLARIZATION OF 300 MEV PROTONS. A Ghosh.

n J. Phys., Vol. 33, No. 5, 197-200 (May, 1959).

Analysis was made in Born approximation for Woods—Saxon of nucleon—nuclear potential with spin—orbit coupling.

539.12

5348 NEW SEMIPHENOMENOLOGICAL PROTON—PROTON POTENTIAL. R.A.Bryan.

o Cimento, Vol. 16, No. 5, 895-902 (June 1, 1960).

A static plus spin—orbit proton—proton potential model has derived semiphenomenologically. The potential resolves nptotically to the ion-pion-exchange potential and has been in the region within r = 1.5ħ/μc by matching the 310 MeV Gregor—Moravcsik—Stapp phase-shift solution no. 1. The re- ng potential gives an improved fit to the p—p scattering data the 40 to 310 MeV energy range.

539.12

5349 ANELASTICITY OF p—p COLLISIONS AT 2.7 BeV. W.M.Bugg and D.T.King.

. Rev., Vol. 119, No. 4, 1408-10 (Aug. 15, 1960).

By following the tracks of particles in a direction generally rary to that of the incident 2.7 BeV proton beam, a series of rvations interpreted as p—p collisions was made in nuclear sions.. The angular and momentum distributions of particles ing from these interactions, and hence the relative occurrence -p collisions with different pion multiplicities, are in reason- accord with previous work. An attempt is made to distinguish e pion production processes from those of double production. though the c.m. kinetic energy distributions for the respective uction modes are markedly different, the corresponding anelast- characteristics show a general similarity.

539.12

5350 PRODUCTION OF NUCLEON ISOBARS IN PROTON—PROTON COLLISIONS. G.B.Chadwick, G.B.Collins, .Swartz, A.Roberts, S. DeBenedetti, N.C.Hien and P.J.Duke.

s, Rev. Letters. Vol. 4, No. 12, 611-13 (June 15, 1960).

Momentum spectra were obtained for protons scattered at (laboratory) in p—p collisions for incident proton energies of , 1.20, 1.35, 1.60 and 1.74 and 2.04 GeV. Magnetic analysis used and the target was 15 in. of liquid hydrogen. At the lower gies (e.g., 1.20 GeV) there was good agreement with the pre- ion of the 3,3 isobar model for single pion production. Where le pion production was appreciable (e.g., 1.60 GeV) the agreement still with the isobar model for single production, suggesting this is dominant at small angles. There was no evidence at er energies (e.g., 2.04 GeV) of isobars corresponding to the er energy resonances in pion—nucleon scattering.

A.Ashmore

539.12

15351 PROTON—PROTON SCATTERING PHASE SHIFTS AT 150 MeV. R.C.Stabler and E.L.Lomon.

vo Cimento, Vol. 15, No. 1, 150-2 (Jan. 1, 1960).

Report of a phase-shift analysis of Harvand scattering data), P(θ) and D(θ)), for partial waves with L ≤ 3. There is one eptable solution, corresponding to Stapp's solution no.1 at MeV (Abstr. 3372 of 1957). R.J.N.Phillips

539.12

15352 PROTON—PROTON SCATTERING IN THE GeV REGION. J. Ōba and T.Gotō.

gr. theor. Phys., Vol. 20, No. 6, 982-3 (Dec., 1958).

A criticism of Bubelev's model of peripheral collisions. This model has given total inelastic scattering correctly, but calculations of elastic scattering and production of two or more pions disagree with experiment. It is concluded that central collisions are significant. R.J.N.Phillips

539.12

15353 DETERMINATION OF THE p—p SCATTERING MATRIX AT 90°. S.B.Nurushev.

Zh. eksper. teor. Fiz., Vol. 37, No. 1(7), 301-2 (July, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 1, 212-13 (Jan., 1960).

The information that can be deduced from experiments between 140 and 635 MeV is summarized in the form of values of b^2, c^2, h^2, δ_C, δ_H, where $b^2 = |B|^2/4I$, $c^2 = 2|C|^2/I$, $h^2 = |H|^2/2I$, $B = |B|e^{i\phi_B}$, $C = |C|e^{i(\delta_C + \phi_B)}$, $H = |H|e^{i(\delta_H + \varphi_C)}$. It is pointed out that to give the black sphere for energies of several GeV, only the amplitude B should remain important. In particular, C and H should decrease with increasing energy. A.Ashmore

539.12

15354 MULTIPLE SCATTERING CORRECTION FOR PROTON RANGES AND THE EVALUATION OF THE L-SHELL CORRECTION AND I VALUE FOR ALUMINUM.

H.Bichsel and E.A.Uehling.

Phys. Rev., Vol. 119, No. 5, 1670-80 (Sept. 1, 1960).

Multiple scattering corrections to proton range-energy measurements are discussed. Curves are plotted which give the fractional transmission of protons through a finite thickness of stopping material as a function of the initial proton energy and for various values of the ratio of the straggling and multiple scattering parameters. An application of these results to particular experimental situations shows that the Molière multiple scattering distribution gives a nearly correct representation of the experimental data on transmission and that a simple exponential distribution is not satisfactory. The case of straggling in gold is discussed in detail. Application of the results to the experimental range—energy relation in aluminium for protons of energy lying between 1 and 20 MeV is made. The experimental ranges can be described consistently with a mean excitation potential I = 163 eV and with reasonable values of the L-shell binding energy correction.

539.12

15355 PROTON—ANTIPROTON ANNIHILATION IN PROTONIUM. B.R.Desai.

Phys. Rev., Vol. 119, No. 4, 1385-9 (Aug. 15, 1960).

Using the model for the nucleon—antinucleon interaction proposed by Ball and Chew (Abstr. 1843 of 1958; 4907 of 1959), the capture rates are calculated for the various eigenstates of protonium—the bound system of a proton and an antiproton. It is found that these rates depend sensitively on spin, isotopic spin, and total angular momentum eigenvaules of protonium, not just on orbital angular momentum, as is usually assumed. The average capture rates for the nS and nP states are $5.3 \times 10^{18}/n^3$ and $4.3 \times 10^{14}/n^3$ sec^{-1}, respectively. This P capture rate is two orders of magnitude larger than in the case of the ($K^- - p$) atom because of the relatively long range of interaction in the Ball—Chew model. The problem of the Stark effect collisions, studied by Day, Snow, and Sucher (Abstr. 13732 of 1959) in connection with the ($K^- - p$)atom, is therefore re-investigated and at the same time certain important effects are studied which were not considered by these authors. Rough calculations indicate that for protonium also the capture will take place predominantly from S states.

539.12

15356 PION MULTIPLICITY IN NUCLEON—ANTINUCLEON ANNIHILATION. B.R.Desai.

Phys. Rev., Vol. 119, No. 4, 1390-4 (Aug. 15, 1960).

In the annihilation problem the influence is considered of the Ball—Chew model according to which, at low energies, only a few of the eigenstates of the nucleon—antinucleon system need be considered. The effect of the selection rules that forbid certain pion multiplicities is thereby examined. The energies considered are 50, 140, and 0 MeV in the case of protonium—the bound system of a proton and and antiproton. To obtain the multiplicity, the author has used the Fermi statistical model but has introduced Lorentz-invariant phase space, thus defining a new interaction volume. It is found that due to selection rules there is a sunstantial change in the number distribution of the outgoing pions. At 140 MeV and in the case of protonium the two-pion production is decreased considerably. The zero-prong events for the $p\bar{p}$ annihilation are suppressed by about a factor of two for annihilations at rest in the case of protonium compared to the corresponding events for annihilations in flight. The over-all average multiplicity is unchanged however. The value of the newly defined interaction volume, in units of Fermi volume for $p\bar{p}$ and $N\bar{p}$ annihilations (where N denotes an "average" nucleon) should be ~ 10 in order to fit the observed multiplicities.

539.12

15357 INELASTIC SCATTERING OF ANTIPROTONS BETWEEN 30 AND 250 MeV.
G.Baroni, C.Castagnoli, A.Manfredini and V.Rossi.
Nuovo Cimento, Vol. 15, No. 6, 899-906 (March 16, 1960). In Italian.

The inelastic scattering of antiprotons in emulsion is studied. The cross-section for this process, already given by a previous paper, is redetermined on the basis of a different criterion. The result $\sigma_i = (65 \pm 20)$ mb is nevertheless confirmed, a value which appreciably differs from that of other authors: $\sigma_i = (42 \pm 11)$ mb. This is due to a more efficient criterion for the identification of the events, based on gap measurements, described in this paper. The inelastic scattering is then analysed by means of the optical model, and a value can be given for the effective cross-section of $\bar{p}$ against bound nucleons: $\sigma_{eff} = (180 \pm 50)$ mb.

539.12

15358 GENERATION OF ANTIPROTONS IN THE INTERACTION OF π^- MESONS WITH NUCLEONS. Van Gan-Chan [Pang Kang-Ch'ang], Van Tsu-Tszen [Pang Tsu-Tseng], Din Da-Tsao [Ting Ta-Ts'ao], V.G.Ivanov, E.N. Kladnitskaya, A.A.Kuznetsov, Nguen Din-Tў, A.V.Nikitin, S.Z.Otvinovskii and M.I.Solov'ev.
Zh. eksper. teor. Fiz., Vol. 38, No. 3, 1010-11 (March, 1960). In Russian.

The work was carried out with a propane bubble chamber provided with a magnetic field of 13 000 Oe. Two events involving antiprotons generated by 7 GeV π^--mesons are illustrated and discussed. G.Martelli

Neutrons

539.12

15359 ENERGY DISTRIBUTION OF NEUTRONS FROM Ra-D—Be SOURCE. B.Sen.
Indian J. Phys., Vol. 33, No. 4, 158-64 (April, 1959).

The energy distribution of neutrons from Pb^{210}—Be source has been studied with photographic plates. The effect of scattering of these neutrons in lead was investigated also. The neutron peaks in the energy distribution curve correspond to different levels of C^{12}. The discrepancies are discussed.

539.12

15360 SCATTERING OF SLOW NEUTRONS BY MOLECULES OF LIQUID WATER, AMMONIA AND HYDROGEN SULFIDE. A.Wanic.
Acta Phys. Polon., Vol. 18, No. 3, 255-62 (1959)

Theoretical curves for neutron scattering cross-section versus energy for H_2O, NH_3 and H_2S were compared with the experimental values for these substnnces in the liquid state. Disagreement obtained at low energy region was interpreted as an evidence of non-existence of any free rotation of molecules in investigated liquids.

539.12 : 532.7

COLD NEUTRON SCATTERING IN WATER. See Abstr. 14648

539.12 : 532.7

NEUTRON SCATTERING BY FLUIDS AND THE LAW OF CORRESPONDING STATES. See Abstr 14650

539.12 : 532.7

LIQUID DYNAMICS AND INELASTIC SCATTERING OF NEUTRONS. See Abstr. 14651

539.12

15361 MEASUREMENTS OF THE TRANSPORT MEAN FREE PATH OF THERMAL NEUTRONS IN BERYLLIUM AS A FUNCTION OF TEMPERATURE. G.deSaussure and E.G.Silver.
Nuclear Sci. Engng, Vol. 6, No. 2, 159-60 (Aug., 1959).

The pulsed neutron technique for measuring the transport mean free path was used to find the value for beryllium as a function of the temperature. The results when compared with the values calculated by Singwi and Kothari (Abstr. 7360 of 1960) show good agreement. J.F.Hill

15362 THE AGE OF PLUTONIUM—BERYLLIUM NEUTR IN LIGHT WATER. F.A.Valente and R.E.Sullivan.
Nuclear Sci. Engng, Vol. 6, No. 2, 162 (Aug., 1959).

Preliminary results are given for age measurements of Pu—Be neutrons in water as an alternative to the usual method using Po—Be neutrons. Three lower energy limits are used, namely the In^{115}, Rh^{103}, and Ag^{109} resonances. J.F

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15363 POLYNOMIAL APPROXIMATIONS IN NEUTRON TRANSPORT THEORY. W.R.Conkie.
Nuclear Sci. Engng, Vol. 6, No. 4, 260-6 (Oct., 1959).

The Milne problem, with absorption, of neutron transport t is solved by expanding the angular distribution in Tchebycheff p nomials, rather than the more conventional Legendre polynomia It is shown that the Tchebycheff approximation of order N, the approximation, gives results for the extrapolated end point whic closer to the exact results over most of the range of absorptio values considered than the corresponding P_N approximation.

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15364 AN ITERATIVE METHOD IN NEUTRON TRANSPOR THEORY. W.R.Conkie.
Nuclear Sci. Engng, Vol. 6, No. 4, 267-71 (Oct., 1959).

An iterative method for solving problems in neutron transp theory is described. The method uses the result of a low-orde spherical harmonics calculation as the initial function and atten to improve this with one iteration. The results for the one-vel Boltzmann equation with plane symmetry show that good accura obtained for many practical cases.

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15365 CONSTRUCTION OF A 14 MeV NEUTRON GENERAT UTILIZING $T^3(d, n)He^4$ REACTION AND MEASUREME OF FAST NEUTRON FLUX. B.Mitra.
Indian J. Phys., Vol. 33, No. 4, 149-57 (April, 1959).

Construction of a low voltage accelerating machine for acce ating deuterons which is utilized as a source of production of 14 neutrons, by $T^3(d, n)He^4$ reaction, is described. Neutron countin carried out by counting recoil protons in a suitable scintillation counter. Neutron yield has also been measured indirectly from saturated activity of an irradiated thin silver foil. Increase in relative flux with increasing deuteron energy from 30 keV to 0.1 has been obtained.

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15366 THERMAL NEUTRON INELASTIC SCATTERING EFFECTS IN A SINGLE CRYSTAL NEUTRON SPEC METER. V.P.Duggal.
Nuclear Sci. Engng., Vol. 6, No. 1, 76-8 (July, 1959).

The thermal neutron spectrum from the "Apsara" swimmin pool type reactor was measured with a single crystal neutron spectrometer and it was found that the variation of the neutron counting rate with Bragg angle showed fluctuations which were n higher than the statistical errors. It is shown that some of thes fluctuations are due to inelastic scattering of thermal neutrons b the crystal. C.F.Barr

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15367 CALIBRATION OF MANGANESE AND GOLD FOILS RELATIVE NEUTRON FLUX MEASUREMENTS. K.G.Stephens and W.M.Cooper.
Brit. J. appl. Phys., Vol. 11, No. 8, 342-5 (Aug., 1960).

The usual method of intercalibrating foils for relative flux measurements, made by comparing the β^- activities of the foils after exposure to the same neutron flux, is compared with a met dependent on weighing the foils. The mass intercalibrations agr to within ±1% of the activity intercalibrations for gold and manga foils in the range 90 to 100 mg/cm^2 thick, if a theoretical correc estimating the β^- absorption in the foil is applied to the measur mass values.

53

15368 AN EFFICIENT COUNTING SYSTEM FOR THE DETECTION OF NEUTRONS FROM LOW-YIELD PULS NEUTRON SOURCES. L.Ruby and J.B.Rechen.
Nuclear Sci. Engng, Vol.6, No.4, 272-8 (Oct., 1959).

This system uses a large organic scintillator as a moderato for a burst of fast neutrons, many of which are subsequently ca tured by the hydrogen in the scintillator. The pulses produced b the 2.2 MeV capture γ-rays are observed by four photomultiplier es whose anodes are paralleled. The output pulses are amplified counted by a 10 Mc/s scaler. The scaler is gated to count for μsec after the pulse, during which interval background is very all. Statistically significant information on total neutron output y be obtained for as few as 10^3 neutrons per pulse, with practi- ly no upper limit. Relative calibration of the system is simple, absolute calibrations are stable and reproducible.

539.12 : 539.2 : 548.7

15369 A UNIVERSAL DOUBLE-CRYSTAL NEUTRON SPECTROMETER. D.O'Connor and L.Bońkowski.

ta phys. Polon., Vol. 18, No. 3, 265-70 (1959).

The construction of a universal double crystal neutron spectro- ter of high precision is described. The instrument can be used double- or single-crystal neutron spectrometry, as a neutron nochromator for cross-section measurements in the range 0.03 10 eV, and as a diffractograph for powder diffraction crystallo- aphic studies. Some illustrative results of measurements are ven.

539.12

15370 THE NEUTRON CRYSTAL SPECTROMETER OF THE INSTITUTE OF ATOMIC PHYSICS - BUCHAREST.

Bally, E.Țarină, S.Todireanu and I.Olteanu.

ev. de Physique (Bucarest), Vol. 5, No. 1, 83-90 (1960).

Describes a high resolving power neutron spectrometer pable of operating both with a plane crystal and with a bent one. ne resolving power was 0.53 μsec/m for a calcite plane crystal, d 1.23 μsec/m for the planes $(10\bar{1}0)$ of a curved quartz crystal. ne minimum Bragg angle that could be clearly noticed by means of e instrument was $1^{\circ}7'$ for the calcite crystal, corresponding to energy of 5.5 eV. This range could be extended to 38 eV by ing the planes $(13\bar{4}0)$ of the quartz crystal. I.C.Demetsopoullos

539.12 : 539.17

DELAYED-NEUTRON MONITORS. See Abstr. 13381

esons

539.12

15371 ON THE TWO FLUID MODEL IN MULTIPLE PRODUCTION OF MESONS. M.Hamaguchi.

ovo Cimento, Vol. 17, No. 1, 35-44 (July 1, 1960).

The mechanism of multiple particle production in high energy cleon—nucleon collisions is investigated using the two fluid model. ne theoretical inelasticity is numerically calculated.

539.12

15372 THE EXCITED NUCLEON'S MODEL OF MESON PRODUCTION. U.Maor and G.Yekutieli.

ovo Cimento, Vol. 17, No. 1, 45-67 (July 1, 1960).

A model of meson production from excited nucleons is described r both nucleon—nucleon and nucleon—nucleus collisions induced cosmic-ray particles. The results are compared with obser- tions in photographic emulsions, and reasonable agreement is ind.

539.12

15373 MESON PRODUCTION IN MESON—NUCLEON INTERACTION. S.K.Kundu.

ogr. theor. Phys., Vol. 20, No. 6, 939-47 (Dec., 1958).

Meson production by mesons in the low-energy limit has been -examined in the frame of static model of the extended source eory. Using Feynman's technique the calculation has been per- rmed up to fifth order in the coupling constant. The renormaliza- n procedure is the same as developed and applied by Chew in eson—nucleon scattering processes. To reduce the Feynman gram an approximation similar to that of the Tamm—Dancoff pe has been used. The total cross-section for charged and utral pions from the pion—nucleon collision in the $T = \frac{3}{2}$, $J = \frac{3}{2}$ te are obtained for incident meson energy 260 to 570 MeV. e theoretical results have been compared with those of Franklin, rshay and others. Franklin's result that production of charged ns is higher than that of neutral pions in the cut-off theory is nfirmed. The present calculation predicts the charged pion oduction of about 7 mb at 500 MeV, against the available expe- nental cross-section of a maximum of 10 mb at the same energy.

539.12

15374 DECAY ELECTRON SPECTRUM FROM BOUND μ^--MESONS. H.Überall.

Nuovo Cimento, Vol. 15, No. 1, 163-5 (Jan. 1, 1960).

Calculates the μ^- decay electron spectrum for light point nuclei, to first order in $\gamma = Ze^2/\hbar c$. Also gives the decay rate to order γ^2: no term of order γ is found, though experiment indicates one, which suggests that the point nucleus model is inadequate.
R.J.N.Phillips

539.12

15375 FURTHER EXPERIMENTAL EVIDENCE CONCERNING THE FERMI—TELLER "Z-LAW". J.F.Lathrop, R.A.Lundy, R.A.Swanson, V.L.Telegdi and D.D.Yovanovitch.

Nuovo Cimento, Vol. 15, No. 5, 831-4 (March 1, 1960).

The time distribution of electrons was observed from negative μ-mesons decaying in Ag—Zn alloy and in a crystal of Li^6I. Both gave results in agreement with the Fermi-Teller "Z-law". This is as expected for the alloy but previous measurements on insulators (Abstr. 1856 of 1958) had given capture rates in proportion to the numbers of atoms and not the "Z-law". The ratio of capture rates in Li^6I was I/Li = 15.8 ± 2.0 compared with the "Z-law" prediction of 17.6. This makes Li^6I unsuitable for studying μ-capture in Li^6.
A.Ashmore

539.12

15376 MOMENTUM AND ASYMMETRY SPECTRUM OF μ-MESON DECAY. R.J.Plano.

Phys. Rev., Vol. 119, No. 4, 1400-8 (Aug. 15, 1960).

The beta decay of the μ^+-meson was studied using a liquid hydrogen bubble chamber in a magnetic field of 8800 G. An analysis of 9213 events used in the momentum spectrum yielded $\rho = 0.78 \pm 0.025$. This number includes the internal radiative corrections and is to be compared directly with the value 0.75 predicted by two-component theory. The analysis of 8354 events used in the asymmetry spectrum gave for the magnitude of the asymmetry $|\xi| = 0.94 \pm 0.07$ and for the shape parameter $\delta = 0.78 \pm 0.05$.

539.12

15377 μ-MESON DECAY INTO THREE ELECTRONS. M.Bander and G.Feinberg.

Phys. Rev., Vol. 119, No. 4, 1427-9 (Aug. 15, 1960).

The decay $\mu^- \to e^- + e^- + e^+$ via internal conversion is computed using a phenomenological matrix element for the $\mu e \gamma$ interaction. The result is compared with present experimental limits for this process and the results concerning the form factors in the matrix element are discussed. The energy distribution of the emitted electrons is also computed.

539.12 : 539.18

DECAY OF μ^- MESONS BOUND IN THE K SHELL OF LIGHT NUCLEI. See Abstr. 13425

539.12

15378 ASYMMETRY OF ANGULAR DISTRIBUTION OF $\mu^+ \to e^+$ DECAY ELECTRONS IN A 27 000 GAUSS MAGNETIC FIELD. S.A.Ali-Zade, I.I.Gurevich, Yu.P.Dobretsov, B.A.Nikol'skii and L.V.Surkova.

Zh. eksper. teor. Fiz., Vol. 36, No. 4, 1327-9 (April, 1959). In Russian. English translation in: Soviet Physics (New York), Vol. 36(9), No. 4, 940-2 (Oct., 1959).

In nuclear emulsion 11 166 π—μ—e decays were observed with μ-mesons at angles 0-30° and 150-180° to a magnetic field, H, of 27 000 gauss. The asymmetry coefficient (a) was found to be 0.305 ± 0.019, and the value after correction for precession of the muon spin about H was 0.324 ± 0.020, very close to the value $\frac{1}{3}$ expected for a V—A or V+A interaction. E.J.Burge

539.12 : 539.16

15379 ELECTROMAGNETIC CORRECTIONS TO THE DECAYS OF THE MUON, O^{14}, AND THE NEUTRON.

L.Durand, III, L.F.Landovitz and R.B.Marr.

Phys. Rev. Letters, Vol. 4, No. 12, 620-4 (June 15, 1960).

Calculations of these corrections are made using a dispersion relation technique. In order to avoid infrared divergencies it is necessary to introduce modified definitions of the coupling constants, so that the equality of G_V and G_μ expected on the Feynman—Gell-Mann theory, should not necessarily hold. It appears, however, to be in close agreement with experiment. E.J.Squires

539.12

15380 THE EXPLANATION OF THE ELECTRON–MUON MASS DIFFERENCE. H.Pietschmann.
Acta phys. Austriaca, Vol. 13, No. 2-3, 315-17 (1960). In German.

The possibility that the electron–muon mass difference is due to the coupling of the muon with a σ-meson is discussed in lowest order. Four different combinations of σ-parity and type of coupling are considered. It is shown to be unlikely that a simultaneous fit to the muon mass and magnetic moment can be found. E.J.Squires

539.12

15381 ON THE MASSES OF μ-MESONS AND ELECTRONS. Ya.B.Zel'dovich.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1817-19 (Dec., 1959). In Russian.

Suggestion for a theory where the masses of μ-mesons and electrons can be derived from the coupling constants of weak and electromagnetic interactions. G.Martelli

539.12

15382 ANOMALOUS MOMENT OF THE μ-MESON FOR DIFFERENT MODELS OF BREAKDOWN OF QUANTUM ELECTRODYNAMICS. B.de Tollis.
Nuovo Cimento, Vol. 16, No. 1, 203-5 (April 1, 1960).

Calculates the correction to the magnetic moment from certain modifications of the propagator or of the electromagnetic vertex. R.J.N.Phillips

539.12 : 539.17

15383 THE NONRADIATIVE CONVERSION OF μ-MESONS TO ELECTRONS. I.S.Shapiro.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1646-7 (May, 1960). In Russian.

It is suggested that the process $\mu^- + A_Z - A_Z{}^* + e^-$, in which a μ-meson is transformed into an electron by interaction with a nucleus which is left in an excited state, might be observed by searching for the emission of α-particles from the final state for certain particular transitions. The ratio of this effect to the capture probability of the muon by the nucleus is calculated and shown to depend on the magnitude of the electric form factor for the μ–e transition. Possible competition from a similar process in which the muon decays first, and the decay electron causes the nuclear transition, is considered. R.F.Peierls

539.12

15384 MUON ABSORPTION IN LIQUID HYDROGEN. S.Weinberg.
Phys. Rev. Letters, Vol. 4, No. 11, 575-8 (June 1, 1960).

It is shown that it is possible to include the effect of the formation of p–μ–p molecular ions, in the interpretation of muon absorption in liquid hydrogen in terms of the $pn\mu\nu$ interaction. The ion is formed predominantly in the ortho-state and absorption for this state is evaluated using previously calculated wave-functions. Possible experimental tests of the approximations made are suggested. E.J.Squires

539.12 : 539.17

15385 MUON CAPTURE IN ^{12}C. M.Morita and A.Fujii.
Nuovo Cimento, Vol. 15, No. 5, 850-2 (March 1, 1960).

The Fujii–Primakoff calculation of the partial transition rate for $\mu^- + C^{12} \rightarrow B^{12} + \nu$, with B^{12} in its ground state (Abstr. 8472 of 1959) was repeated with relativistic corrections included. Results are given as a function of the ratio of the pseudo-scalar and axial vector coupling constants, with and without the inclusion of the magnet moment term arising from the assumption of a conserved vector current. A.Ashmore

539.12

15386 THE AXIAL VECTOR CURRENT IN BETA DECAY. M.Gell-Mann and M.Lévy.
Nuovo Cimento, Vol. 16, No. 4, 705 (May 16, 1960).

In order to derive in a convincing manner the formula of Goldberger and Treiman for the rate of charged pion decay, the possibility is considered that the divergence of the axial vector current in β-decay may be proportional to the pion field. Three models of the pion–nucleon interaction (and the weak current) are presented that have the required property. The first, using gradient coupling, has the advantage that it is easily generalized to strange particles, but the disadvantages of being unrenormalizable and of bringing in the vector and axial vector currents in an unsymmetrical way. The second model, using a strong interaction proposed by Schwinger and a weak current proposed by Polkinghorne, is ren alizable and symmetrical between V and A, but it involves post a new particle and is hard to extend to strange particles. The t model resembles the second one except that it is not necessary introduce a new particle. (Renormalizability in the usual sense then lost, however). Further research along these lines is sugg including consideration of the possibility that the pion decay rat may be plausibly obtained under less stringent conditions.

5

15387 ON THE INFLUENCE OF THE ANOMALOUS MOME OF THE BARYONS IN THE DECAY OF π^0 IN TWO γ-RAYS. A.H.Zímerman.
Nuovo Cimento, Vol. 15, No. 3, 492-5 (Feb. 1, 1960).

The anomalous moments of the intermediate baryons lead t markedly different results for the model of Gell-Mann and that Tiomno. W.A.He

5

15388 SPACE ASYMMETRY OF LOW-ENERGY POSITRON FROM $\pi^+ - \mu^+ - e^+$ DECAY. A.O.Vaisenberg.
Zh. eksper. teor. Fiz., Vol. 37, No. 2(8), 566-8 (Aug., 1959). In Russian. English translation in: Soviet Physics—JEPT (New Yo Vol. 37(10), No. 2, 401-2 (Feb., 1960).

The data obtained in the author's laboratory are discussed compared with the results of other authors. The observed value do not contradict predictions of the two-component theory. G.Mart

53

15389 A NEW MEASUREMENT OF THE MEAN LIFE OF T POSITIVE PION. J.Ashkin, T.Fazzini, G.Fidecaro, Y.Goldschmidt-Clermont, N.H.Lipman, A.W.Merrison and H.Pa
Nuovo Cimento, Vol. 16, No. 3, 490-504 (May 1, 1960).

The mean life of the positive π-meson was determined from about 8000 $\pi\mu$ decay events recorded by photographing pulses on oscilloscope. The pictures were measured with an instrument originally developed for the evaluation of bubble-chamber pictur and the data were analysed using a fast computer. The value obtained for the mean life of the π-meson is $\tau_\pi = 25.46 \pm 0.32$ nsec

53

15390 THE ANGULAR DISTRIBUTION OF SECONDARY π-MESONS FROM 4.5 GeV π^- AND 6 GeV PROTON INTERACTIONS IN EMULSION. H.H.Aly and C.M.Fisher.
Nuovo Cimento, Vol. 17, No. 1, 98-105 (July 1, 1960).

The angular distributions of π-mesons produced in two hund 4.5 GeV π^- and two hundred 6 GeV proton interactions with emul nuclei have been investigated. It is found that the pions from the 6 GeV proton induced interactions are consistent with an isotropi distribution in the C-system whilst the pions from the 4.5 GeV π^- induced interactions have an anisotropic distribution peaked in th forward direction. The degree of anisotropy is larger with small N_h values.

539

15391 INCOMPATIBILITY BETWEEN THE HYPOTHESIS O RESTRICTED SYMMETRY AND CERTAIN EXPERIMENTAL RESULTS. B.d'Espagnat and J.Prentki.
Nuovo Cimento, Vol. 15, No. 1, 130-46 (Jan. 1, 1960). In French.

Discusses two ways of estimating matrix elements for $\Lambda\pi$ and $\Sigma\pi$ scattering in the presence of K interactions, from assumption about these elements in the absence of K interactions. In each c the assumption of restricted symmetry ($g_{\Lambda\Sigma\pi} = g_{\Sigma\Sigma\pi}$) leads to co flict with the low-energy K^-–p data. It is concluded that this sym metry either does not hold or is so masked by K-interactions as t be useless. [However, a note in proof adds that small modificatio to the data could change this negative result]. R.J.N.Philli

539.

15392 PION RESONANCES. J.J.Sakurai.
Nuovo Cimento, Vol. 16, No. 2, 388-91 (April 16, 1960).

Discusses the evidence for resonances in the two-pion and th pion systems, which have been proposed by Chew and others, and which are required by the author's theory of strong interactions (t be published). Lists various puzzles such resonances may help to solve. R.J.N.Philli

539.12

15393 ELECTRON PAIR CREATION IN π^- + p CAPTURE REACTIONS FROM REST. D.W.Joseph.

ovo Cimento, Vol. 16, No. 6, 997-1013 (June 16, 1960).
Electromagnetic corrections are calculated for the processes
$+ p \to n + e^+ + e^-$ and $\pi^0 \to \gamma + e^+ + e^-$. These corrections
pend on the c.m. energy of the pair. For very low c.m. energy
corrections are relatively large, and due mainly to the electron—
sitron Coulomb attraction; they fall rapidly with increasing c.m.
ergy to a minimum of 0.5%, then rise slowly to a value of 1.7% at
highest c.m. energy. For both processes, the correction to the
al rate amounts to about 1%. In terms of these total rates, the
nofsky ratio is found to be

$$= 0.594\ P[\pi^- + p \to n + \pi^0, \pi^0 \to \gamma + e^+ + e^-]/P[\pi^- + p \to$$
$$\to n + e^+ + e^-].$$

r the process $\pi^- + p \to n + e^+ + e^-$, the problem of empirically
ntifying the contributions arising from interaction via the
gitudinal component of the electromagnetic field and from size
ects is discussed. These contributions are expected to amount
only 2.0% and 0.8%, respectively, of the total rate. The process
$+ p \to n + 2\gamma$ is also discussed briefly.

539.12

15394 THE DISPERSION RELATION AND THE PION—NUCLEON INTERACTION CROSS SECTION AT VERY GH ENERGIES. T.Sakuma, S.Furui and A.Kanazawa.

ogr. theor. Phys., Vol. 20, No. 6, 835-43 (Dec., 1958).
Using the dispersion relations, the sum of the total cross-
ctions for the π^+—p and π^-—p interactions are evaluated at very
gh energies, under the assumption that the cross-sections are
nstants above a certain very high energy. The numerical value
the sum of the cross-sections is determined mainly by the
npirical data at low energies (less than 2 BeV). The analysis
ves the sum of the cross-sections a few times larger than twice
e geometrical cross-section obtained by assuming that the "radius"
the nucleon is the pion Compton wavelength. Since the dispersion
lations seem to be consistent with the experiments at low energies
is strongly suggests that the dispersion relation would break down
very high energies.

539.12

15395 DETERMINATION OF THE PION—NUCLEON COUPLING CONSTANT BY MEANS OF THE UCLEON—NUCLEON DISPERSION RELATION. S.Matsuyama.

rogr. theor. Phys., Vol. 21, No. 3, 452-8 (March, 1959).
Making use of the dispersion relation for nucleon—nucleon
cattering, the coupling constant between pion and nucleon is deter-
ined from the neutron—proton scattering length in the triplet state
d the binding energy of the deuteron. The coupling constant $g^2/4\pi$
us determined coincides with those deduced by other theories.

539.12

15396 ANGULAR ASYMMETRY IN π—N COLLISION AND THE π—π INTERACTION. V.S.Barashenkov.

. eksper. teor. Fiz., Vol. 37, No. 5(11), 1464-6 (Nov., 1959).
Russian.
Numerical results of a calculation are given, where the multi-
icity of various particles generated in meson—nucleon collisions
calculated according to the theory developed by Tamm (1960) and
e author himself (Abstr. 4088 of 1960, model of "central" and
eripheral" collisions). G.Martelli

539.12

15397 ROLE OF THE π—π INTERACTION IN HIGH-ENERGY π—NUCLEON INTERACTIONS.

.Carruthers and H.A.Bethe.
hys. Rev. Letters, Vol. 4, No. 10, 536-9 (May 15, 1960).
The pion—nucleon interaction is pictured as being controlled
the interaction between the incident pion and a virtual pion, one
both of which interact with the nucleon via the 3-3 resonance.
$-\pi$ states with isotopic spin t = 0 and 1 are taken to be respectively
ominant in the regions of the second (0.6 GeV) and third (0.9 GeV)
esonances. From the ratio of the cross-sections $\pi^- + p \to \pi^- + \pi^+ + n$
d $\pi^- + p \to \pi^- + \pi^0 + p$, a pronounced maximum is found in the
= 1 amplitude at 0.9 GeV. The model explains why the resonances
e $D_{3/2}$ and $F_{5/2}$, and not $D_{5/2}$ and $F_{7/2}$. It will also give a D_{33}
esonance as a possible explanation of the rise in the π^+—p cross-
ection above 0.8 GeV. A.Ashmore

539.12

15398 THE PROBLEM OF THE RESONANCE IN π—π INTERACTIONS. V.M.Maksimenko.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 652-4 (Feb., 1960). In Russian.

Discussion of the expected angular correlations in the reaction $\bar{N} + N \to \pi^+ + \pi^- + \pi^0$ (where $\bar{N}$ and N indicate antinucleon and nucleon respectively). G.Martelli

539.12

15399 POSSIBILITY OF OBTAINING INFORMATION ON THE π—π INTERACTION FROM NUCLEAR REACTIONS.

Yu.D.Bayukov and G.A.Leksin.
Zh. eksper. teor. Fiz., Vol. 38, No. 6, 1907-8 (June, 1960). In Russian.

The cross-section for the reaction $\pi(A,B)\pi\pi$ is expressed in terms of the π—π cross-section. The particular experiment $\pi^-(C^{12},N^{12})\pi^-,\pi^-$ is proposed as a convenient test of this suggestion. D.W.L.Sprung

539.12

15400 PION PHOTON SCATTERING. M.Gourdin and A.Martin.

Nuovo Cimento, Vol. 17, No. 2, 224-43 (July 16, 1960).

Combining the assumption of a Mandelstam representation with approximate unitarity one can get the pion—photon scattering amplitude in terms of the pion—pion scattering amplitude in even states and of the matrix element for photoproduction of pions on pions. In solving this problem attention must be paid to the fact that in the low energy limit this amplitude should become equal to the classical amplitude. With some simplifying assumptions an expression is obtained which contains four quantities: the two pion S-phase shifts, the total cross-section for photoproduction of pions on pions, and the electromagnetic coupling constant. The interest of studying this process lies in its possible influence on the nucleon—photon scattering.

539.12

15401 DISPERSION RELATION PREDICTIONS FOR π,p SCATTERING. T.D.Spearman.

Nuovo Cimento, Vol. 15, No. 1, 147-9 (Jan. 1, 1960).

Using revised values for the s-wave scattering lengths and the most recent available total cross-section data at high energies, it is shown that the forward scattering dispersion relations for pion—nucleon scattering give good agreement with experiment for both π^+ and π^- scattering, with the coupling constant required to lie in the range 0.08 ± 0.005. R.F.Peierls

539.12

15402 ELASTIC SCATTERING π^- + p AT 915 MeV. S.Bergia, L.Bertocchi, V.Borelli, G.Brautti, L.Chersovani, L.Lavatelli, A.Minguzzi-Ranzi, R.Tosi, P.Waloschek and V.Zoboli.

Nuovo Cimento, Vol. 15, No. 4, 551-64 (Feb. 16, 1960).

The differential cross-section for elastic scattering $\pi^- + p$ has been determined on the basis of 1421 events observed in a propane bubble chamber. The angular distribution presents a backward bump ($\theta > 90^0$) of (31.5 ± 1.3)%. The amplitude at 0^0 obtained extrapolating the angular distribution by means of a least squares fit is compared with the value obtained from the dispersion relations and the optical theorem. New values of the pion proton cross-sections were taken into account for the dispersion relation integrals. Using the same best fit of the angular distribution a value for the interaction radius is obtained from considerations based on the diffraction scattering part.

539.12

15403 PHENOMENOLOGICAL POTENTIAL FOR π—p SCATTERING IN THE 1 GeV REGION. M.Chrétien.

Nuovo Cimento, Vol. 15, No. 4, 565-70 (Feb. 16, 1960).

It is shown that a nuclear potential with a repulsive core can quantitatively describe the large backward scattering observed in π^-—p scattering for pion energies around 1 GeV. With an infinite repulsive core ($V = \infty$ from 0 to r), surrounded by a complex well ($V = V_r + iV_i$ from r to R) a phase-shift calculation gives best agreement with experiment for $R = 1.1 \times 10^{-13}$ cm, r/R = 0.2, $V_r = -60$ MeV, $V_i = -40$ MeV.

539.12

15404 PARTIAL-WAVE DISPERSION RELATIONS FOR PION—NUCLEON SCATTERING. W.R.Frazer and J.R.Fulco.

Phys. Rev., Vol. 119, No. 4, 1420-6 (Aug. 15, 1960)

Partial-wave dispersion relations for pion—nucleon scattering are derived from the Mandelstam representation. The symmetry of the representation is used to obtain expressions for the discontinuities across the unphysical branch cuts. These expressions involve scattering amplitudes for pion—nucleon scattering and for the process $\pi + \pi \rightarrow N + \bar{N}$. In the approximation of neglecting all but the nearest singularities it is shown that the Chew—Low effective-range formula is a solution to the equations.

539.12

15405 NOTE ON THE STRANGE PARTICLE EFFECTS IN S-WAVE PION—NUCLEON SCATTERING.

K.Nakayama.
Progr. theor. Phys., Vol. 19, No. 5, 581-2 (May, 1958).

The S-wave pion—nucleon phase-shifts are calculated, in lowest order, with a particular form for the interactions involving the strange particles. The resulting phase-shifts show large isobaric spin splitting, but disagree with the experimental values.
E.J.Squires

539.12

15406 ON THE CONSISTENCY BETWEEN THE P-WAVE DISPERSION RELATION AND THE EXPERIMENT.

T.Tsuchida and A.Kanazawa.
Progr. theor. Phys., Vol. 20, No. 3, 395-7 (Sept., 1958).

It is shown that when data below 100 MeV are considered, the Chew—Low equations describing the P_{33} pion—nucleon scattering amplitude show the same sort of discrepancy as that discussed by Puppi for the forward-scattering amplitude. R.F.Peierls

539.12

15407 SOME REMARKS ON THE SCATTERING PROBLEM.

M.Ida.
Progr. theor. Phys., Vol. 20. No. 6, 979-80 (Dec., 1958).

Discusses the inapplicability of Levinson's theorem (relating the phase shift at infinite energy to the number of bound states) to π—N scattering. R.J.N.Phillips

539.12

15408 EFFECT OF A PION—PION SCATTERING RESONANCE ON LOW ENERGY PION—NUCLEON SCATTERING.

J.Bowcock, W.N.Cottingham and D.Lurié.
Nuovo Cimento, Vol. 16, No. 5, 918-38 (June 1, 1960).

From the analytic properties of the pion—nucleon scattering amplitude postulated by Mandelstam, a fixed momentum transfer dispersion relation in the energy variable is derived which should be valid at low energies. This formulation allows evaluation of the effect of a two-pion scattering resonance on pion—nucleon scattering. By a suitable choice of the pion—pion resonance parameters both the experimental pion—nucleon phase shifts and the nucleon electromagnetic form factors can be fitted

539.12

15409 PION PRODUCTION AND THE "ISOBARIC" MODEL.

S.Bergia, F.Bonsignori and A.Stanghellini.
Nuovo Cimento, Vol. 16, No. 6, 1073-84 (June 16, 1960).

A model is proposed in order to take into account interference effects between different (33) isobaric channels in pion production. Within the one GeV energy region the qualitative features of the Lindenbaum and Ternheimer isobaric model are confirmed. At lower energies the interference modifies radically the isobaric spectra.

539.12

15410 PION—MOMENTUM SPECTRUM FROM K^- ABSORPTION IN HELIUM.

J.Leitner and S.Lichtman.
Nuovo Cimento, Vol. 15, No. 5, 719-28 (March 1, 1960).

The pion—momentum spectrum from K^--absorption stars in helium is calculated in the impulse approximation. The kaon is assumed to be pseudoscalar and to be captured from the 1s state. A final state consisting of free particles is used. The effect of final bound states is considered and taken into account phenomenologically. All final-state interactions are neglected. It is shown that the shape of the momentum spectrum is determined mainly by kinematics, i.e., the shapes and position of the spectral peaks are quite insensitive to detailed dynamical assumptions such as the nature of the K parity and capture orbit. The effect of final-state interactions is discussed.

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15411 AN EXPERIMENTAL TEST OF PARITY CONSERV TION IN π^0-MESON PRODUCTION BY NEUTRONS.

D.G.Davis, R.C.Hanna, F.F.Heymann and C.Whitehead.
Nuovo Cimento, Vol. 15, No. 4, 641-51 (Feb. 16, 1960).

A carbon target was bombarded with a beam of transversel
polarized neutrons of energy up to 540 MeV. π^0 mesons ejected
right angles to the neutron beam were detected through their de
γ-rays in energy-sensitive Cherenkov counters. A fore—aft as
metry in π^0 production relative to polarization vector of the neu
beam was sought which would have been indicative of a parity vi
lating term of the form $\sigma_n . k_{\pi^0}$. A reversible longitudinal magn
field was used to precess the neutron beam polarization vector
enable the asymmetries to be measured with minimal systemati
errors. The experiment was sensitive to asymmetries of 1 in 1
Values of P, the parity violating polarization in the reaction, of
−0.005 ± 0.020 to −0.079 ± 0.050 were found for π^0 mesons of
various energies.

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15412 LOW ENERGY PHOTOPRODUCTION OF NEUTRAL MESONS FROM COMPLEX NUCLEI.

R.A.Schrack, S.Penner and J.E.Leiss.
Nuovo Cimento, Vol. 16, No. 4, 759-61 (May 16, 1960).

Preliminary results are given for the angular distribution o
π^0-mesons produced by 170 MeV bremsstrahlung in Pb, Cd, Cu,
and C. Comparison is made with the predictions of Born approx
tion for coherent production with form factors from electron
scattering. There is fairly good agreement for the main peak bu
not for the secondary maxima. A.Ashn

15413 PHOTOPRODUCTION OF NEGATIVE AND POSITIV PIONS FROM DEUTERIUM FOR PHOTON ENERGIE 500 TO 1000 MeV.

G.Neugebauer, W.Wales and R.L.Walker.
Phys. Rev., Vol. 119, No. 5, 1726-35 (Sept. 1, 1960).

The ratio of the yields of negative and positive pions photo-
produced in deuterium was measured at six photon energies bet
500 and 1000 MeV and at seven angles between 20° and 160° in th
centre-of-momentum system of the photon and target nucleon.
Pions were selected with a magnetic spectrometer and identifiec
momentum and specific ionization in a scintillation counter tele-
scope. The spectator model of the deuteron was used to identify
photon energy. Statistical errors assigned to the π^-/π^+ ratio ra
between 5 and 15%. The results of the present experiment join
smoothly with the low-energy π^-/π^+ ratios obtained by Sands et
(Abstr. 9633 of 1954). At high energies the π^-/π^+ ratio varies f
0.5 at forward angles and energies near 900 MeV to 2.5 at 160° c
and energies 600 to 800 MeV. The cross-sections for π^- photo-
production from neutrons were derived from the π^-/π^+ ratio anc
previous π^+ photoproduction data. The angular distributions for
π^- production are considerably different from those for π^+; ther
for example, a systematic increase at the most backward angles.
The energy dependence of the total cross-section for π^- is simil
to that for π^+, although the second resonance peak occurs at a
slightly lower energy, and at 900 and 1000 MeV the π^- cross-
section is smaller by a factor 1.6. A comparison is made of the
cross-sections for π^+ photoproduction from hydrogen and deuter
although the accuracy of this comparison is not high.

539

15414 PHOTOPRODUCTION OF π^+ MESONS ON HYDROGEN NEAR THE THRESHOLD.

É.G.Gorzhevskaya, V.M.Popova and F.R.Yagudina.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 276-8 (Jan., 1960). In Rus

A polythene—carbon difference technique has been used, in
association with nuclear emulsions, to detect π^+-mesons generat
by a γ-beam with maximum energy of 263 MeV. Two points corr
ponding to the energies of 152.9-158.3 MeV and 158.3-161 MeV ha
been measured so far, the energy of the detected mesons ranging
from 0.5 MeV to 6 MeV and their angular distribution in the labo-
ratory system, from 60° to 120°. Within fairly large statistical
errors, the points agree with theoretical predictions and with the
results of other authors. G.Mart

539

15415 PHOTOPRODUCTION OF π^0 MESONS FROM HYDROG IN THE REGION 900 TO 1200 MeV.

H.E.Jackson, J.W.DeWire and R.M.Littauer.
Phys. Rev., Vol. 119, No. 4, 1381-4 (Aug. 15, 1960).

The reaction $\gamma + p \rightarrow \pi^0 + p$ was studied in three adjacent

MeV energy intervals between 900 and 1200 MeV and at pion re-of-mass angles of 47°, 90° and 125°. The reaction was ob-/ed as a coincidence between the recoil proton and one of the .ons from the meson's decay. The kinematics were determined he energy of the incident photon and the angle of the recoil on. The differential cross-sections at the forward and back-d angles show pronounced maxima near 1050 MeV, while the cross-sections decrease slowly with energy. The estimated l cross-sections suggest a narrow maximum near 1050 MeV. se features are consistent with the previously proposed exist-e of a resonant state in the pion—nucleon system of total angular nentum $\frac{5}{2}$.

539.12

15416 PRONG ANALYSIS OF MULTIPLE PRODUCTION OF PIONS AT BEVATRON ENERGY ACCORDING TO A TISTICAL THEORY. F.Cerulus and J.von Behr.

vo Cimento, Vol. 16, No. 6, 1046-67 (June 16, 1960).

A model is proposed in which "central" collisions are treated ording to a statistical theory and "peripheral" collisions accord- to a simple two-centre model. The relative probability of the kinds of collisions is introduced as a new parameter. With this additional parameter it is possible to have agreement with the erimental values of the inelasticity, the average number of pions, ratio of two- to four- to six-prong events, and the average rgies. The introduction of a π—π isobar changes the result, but sent experiments, because of lack of precision, cannot confirm or out this hypothesis. The model predicts also angular distribu-s and some angular correlations, as well as energy spectra. he first part of the present investigation it is shown that a purely tistical model (without "peripheral" collisions) fails to account the rather low inelasticity which is experimentally found, ause it yields too high meson energies and much too low nucleon rgies.

539.12

15417 ON THE PRODUCTION OF PION AND MUON PAIRS BY THE ANNIHILATION OF HIGH-ENERGY POSITRONS.

.Nikishov.

. eksper. teor. Fiz., Vol. 36, No. 4, 1323-4 (April, 1959). In ssian. English translation in: Soviet Physics—JETP (New York), 36(9), No. 4, 937-8 (Oct., 1959).

The probability of the decay of the bound system $\mu^+ \mu^-$ into e^- is estimated to be 4×10^{11} sec^{-1}, and is vanishingly small for $+ \pi^- \rightarrow e^+ + e^-$. E.J.Burge

539.12

15418 THE PRODUCTION OF π-MESONS IN πN-COLLISIONS. A.E.Lebedev and V.A.Petrun'kin.

. eksper. teor. Fiz., Vol. 38, No. 4, 1337-9 (April, 1960). In ssian.

The explanation of the observed pion momentum spectrum from production of pions in π—N collisions is discussed. Calcula-ns are reported which show that the introduction of a π—π reso-nce into the statistical model, in addition to the π—N 33 isobar, es not give any substantial improvement in the agreement with periment. R.F.Peierls

539.12

15419 EXPERIMENT ON CHARGE INDEPENDENCE IN INTERACTIONS OF NUCLEONS AND PIONS. D.Harting, C.Kluyver, A.Kusumegi, R.Rigopoulos, A.M.Sachs, G.Tibell, Vanderhaeghe and G.Weber.

ys. Rev., Vol. 119, No. 5, 1716-25 (Sept. 1, 1960).

The ratio (R) of the differential cross-sections of the reactions $+ d \rightarrow H^3 + \pi^+$ and $p + d \rightarrow He^3 + \pi^0$ was measured at a bombarding ergy $E_p = 591$ MeV. The He^3 and H^3 nuclei are detected by the mbination of magnetic deflection, time-of-flight measurement and lse-height selection. The results are $R = 2.26 \pm 0.11$, 2.10 ± 0.14 d 2.05 ± 0.09 at c.m. angles of the heavy particles of 52°, 67°, and 13°, respectively. The agreement with the predictions of charge dependence is satisfactory when the Coulomb and mass corrections e taken into account.

539.12 : 537.59

15420 PRODUCTION OF PIONS IN CONDENSED MEDIA BY COSMIC RAYS IN THE STRATOSPHERE.

.K.Kaipov, V.N.Shakhorostov and Yu.G.Kosyak.

. eksper. teor. Fiz., Vol. 35, No. 3(9), 825-6 (Sept., 1958). In ssian. English translation in: Soviet Physics—JETP (New York), l. 35(8), No. 3, 573-4 (March, 1959).

Stripped emulsion under aluminium and lead plates of various thicknesses was exposed to cosmic rays at balloon altitudes. The ratio of the production rates of low-energy pions in the two metals was determined as a function of target thickness. It was found that the Pb/Al production ratio exceeds the ratio of the geometric cross-sections at small thicknesses. E.G.Michaelis

539.12

15421 ON THE POSSIBLE EXISTENCE OF DOUBLY STRANGE HEAVY MESONS. J.C.Polkinghorne and A.Salam.

Nuovo Cimento, Vol. 15, No. 1, 166-7 (Jan. 1, 1960).

Production reactions, thresholds and decay processes are discussed for ω-mesons of S = 2 and mass $\sim 1500\ m_e$. Their existence would fill all the gaps in the four-dimensional scheme for mesons. This leads to the speculation that the (0, 1) baryon triplet exists and to a discussion of the properties of its members.
A.Ashmore

539.12

15422 RADIATIVE K—μ DECAY AND QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. K.Hiida.

Progr. theor. Phys., Vol. 21, No. 1, 98-112 (Jan., 1959).

The radiative K—μ decay is analysed as a means of obtaining information on the properties of the muon and quantum electrodynamics at small distances and/or on the type of the weak Fermi interaction. To express modifications of the properties of the muon and of quantum electrodynamics at small distances, cut-off factors are used. Using, for example, Feynman's cut-off factor with cut-off radius $(1/\Lambda) > \sim 0.3 \times 10^{-13}$ cm, it is shown that the effects of these modifications may be measurable with present experimental techniques, provided that the values of the axial vector and vector coupling constants are greater than or equal to that of the tensor coupling constant: $|C_A| \approx |C_V| \geq |C_T|$. If $|C_T| > |C_A| \approx |C_V|$ and $(1/\Lambda) < 0.3 \times 10^{-13}$ cm, on the contrary, the effects of the tensor interaction are measurable. When $(1/\Lambda) > 0.3 \times 10^{-13}$ cm and $|C_T| > |C_A| \approx |C_V|$, it is hard to distinguish these two effects.

539.12

15423 NOTE ON DIVERGENCELESS CURRENTS AND MUON POLARIZATION IN $K_{\mu 3}$ DECAYS.

S.Hatsukade, R.E.Marshak, S.Okubo and E.C.G.Sudarshan.

Nuovo Cimento, Vol. 16, No. 2, 332-41 (April 16, 1960).

The hypothesis of conserved current in weak interaction is examined for the strangeness non-conserving decays. This hypothesis enables the unambiguous calculation of the longitudinal polarization of a muon in $K_{\mu 3}$ decay as a function of the pion energy. Its dependence on the muon energy is also studied. The result is compared with that of Okun and Martinyan who did not use a conserved current.

539.12

15424 PION—PION INTERACTIONS IN τ AND τ' DECAYS. R.F.Sawyer and K.C.Wali.

Phys. Rev., Vol. 119, No. 4, 1429-35 (Aug. 15, 1960).

The final-state interactions in τ and τ' decays of K^+ mesons are studied by means of a Mandelstam representation. It is assumed that only the S-wave pion—pion scattering amplitude is large enough to have an appreciable imaginary part. Coupled, linear, singular, integral equations are found for the amplitudes describing $K^+ + \pi \rightarrow \pi + \pi$ in the physical and unphysical regions. From the solutions to these equations the τ and τ' decay matrix elements may be constructed. In an approximation the equations are solved in terms of pion—pion phase shifts. Comparison with experiment is made using Chew and Mandelstam's solution of the corresponding nonlinear equations for π-π scattering. Consistency with experiment is found for values of the coupling constant implying repulsive T = 0 and T = 2 phase shifts. Independently of the approximation the equations show that the implications in τ and τ' decay of the rule, $\Delta T = \frac{1}{2}, \frac{3}{2}$, are identical with those of the $\Delta T = \frac{1}{2}$ rule. Hence the energy spectra in τ' decay cannot be a critical test of the $\Delta T = \frac{1}{2}$ rule. Also, independently of the approximation, it is shown that the decay matrix element cannot be expanded in a series of integral powers of the pion kinetic energies.

539.12

15425 ON A SYMMETRY IN τ^0 DECAY. M.I.Shirokov.

Zh. eksper. teor. Fiz., Vol. 37, No. 1(7), 328-9 (July, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 1, 232-3 (Jan., 1960).

It is shown that if the decay process $\pi^+ + \pi^- + \pi^0$ is invariant under charge conjugation, then the angular distribution of the

$\pi^+ + \pi^-$ has the symmetry $F(-p,p') = F(p,p')$, where p is the difference and p' the sum of the π^+ and π^- momenta in the c-system.

S.J.Goldsack

539.12

15426 ELECTROMAGNETIC MASS SHIFT FOR SPINLESS PARTICLES. H.Katsumori.

Nuovo Cimento, Vol. 14, No. 6, 1381-3 (Dec. 16, 1959).

Shows that the sign of the $K^{\pm}-K^0$ mass difference can be understood, if the isoscalar and isovector electromagnetic form factors obey $F_S(k)\,F_V(k) < 0$ for large momentum transfer k.

R.J.N.Phillips

539.12

15427 COUPLING CONSTANT OF KAON—BARYON INTERACTION. I.

A.Komatsuzawa, R.Sugano and Y.Nogami.

Progr. theor. Phys., Vol. 20, No. 2, 246-9 (Aug., 1958).

An investigation of approximate solutions of the Low equations for K-meson—nucleon scattering, assuming that there is no KN bound state, puts an upper bound on the K—N coupling constant. It is found that $g^2_{N\Sigma K} + g^2_{N\Lambda K} \leq 1$. The (NΛK) and (NΣK) interactions are assumed to be of the scalar type.

J.S.Dowker

539.12

15428 COUPLING CONSTANT OF KAON—BARYON INTERACTION. II.

A.Komatsuzawa, R.Sugano and Y.Nogami.

Progr. theor. Phys., Vol. 20, No. 2, 249-50 (Aug., 1958).

A more accurate treatment of the low energy K^+—p scattering than that employed in the preceding paper leads to a stronger restriction on the K—N coupling constant: $g^2_{N\Sigma K} + g^2_{N\Lambda K} < 0.7$. Disagreement with available experimental evidence may indicate that the K meson is not scalar.

J.S.Dowker

539.12

15429 REGARDING THE REACTION $K + p \rightarrow \Lambda^0 + 2\pi$. J.E.Russell.

Nuovo Cimento, Vol. 15, No. 5, 697-708 (March 1, 1960).

A recent proposal to determine $P_{K\Lambda}$, the relative KΛ parity, by a study of the reaction $\bar{K} + p \rightarrow \Lambda^0 + 2\pi$, in flight and at low energies, is generalized to include the admittedly remote possibility of a spin 2 K-meson. The appropriate forms of the differential cross-sections are found, the treatment being non-relativistic and strictly phenomenological. The approximation for the matrix elements is based on barrier penetration considerations. Final state interactions are neglected. If the assumptions, which are the same as those made previously, are valid, $P_{K\Lambda}$ may be determined independently of whether the K-meson spin is zero or 2. In addition, there is a possibility of distinguishing spin zero from spin 2.

539.12

15430 THE INTERACTION AND DECAY OF K^--MESONS IN PHOTOGRAPHIC EMULSION. III.

K^--Collaboration (D.Evans, F.Hassan, K.K.Nagpaul, D.J.Prowse, M.René, G.Alexander, R.H.W.Johnston, D.Keefe, D.H.Davis, W.B.Lasich, M.A.Shaukat, F.R.Stannard, A.Bonetti, C.Dilworth, M.Merlin and A.Salandin).

Nuovo Cimento, Vol. 15, No. 6, 873-98 (March 16, 1960).

For Pt II, see Abstr. 1308 of 1960. The mean free path for K^--interaction in flight (10-80) MeV with hydrogen and with complex nuclei in emulsion are compared with other recent experimental data. A number of Σ-hyperons are also investigated. From favourable examples of Σ^+—p decay recorded in the emulsion, the Σ^+ mass is estimated as $M_{\Sigma^+} = 2327.2 \pm 1.0\ m_e$ and from the hydrogen capture ($K^- + H$) events the mass difference ($M_{\Sigma^-} - M_{\Sigma^+}$) is found to be $14.6 \pm 1.1\ m_e$. Lifetime estimates are also given for the charged Σ hyperons: (a) The best estimate for the Σ^+ lifetime is obtained using only events in which the decay proton is emitted forward in the centre-of-mass system. Thus $\tau^+ = 0.82^{+0.34}_{-0.20} \times 10^{-10}$ sec. (b) A representative value for the hypothetical Σ^- lifetime as determined from 70 selected $\Sigma^{\pm}_{\pi}$ decays is $0.71^{+0.19}_{-0.12} \times 10^{-10}$ sec. The effective lifetime appears (as well as can be ascertained) to remain of the order of the Σ^+ lifetime, even in samples containing widely different proportions of Σ^- hyperons. Although values are greater than the lifetimes previously reported in emulsion experiments, it still appears possible that a genuine anomaly may exist. The observed numbers of secondary interactions by charged particles emitted from the K^--capture stars may be accounted for on the basis of proton interactions, although some contribution from deuterons is not excluded. One definite example of a fast Σ interactio (visible energy release 129 MeV) has been found in a length of 7 of track registered in the emulsion. The number of single scatt in 18 cm of Σ^- and 25 cm of Σ^+ hyperon track in emulsion (ener interval 5-100 MeV) are compared with that expected for Coulo scattering by a point nucleus. Only a slight possible indication o the nuclear interaction of the Σ^--hyperon is demonstrated with t few data at present available. In K^--interactions giving ($\Sigma + \pi$) some 45 Σ^+_p and 47 Σ^+_π decays were also examined for possible polarization of the decay with respect to the (Σ,π) plane of production.

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15431 ON THE INTERACTION OF (200-300) MeV K^+-MESO IN EMULSION.

D.Evans, F.Hassan, K.K.Nagpaul and N.Shafi.

Nuovo Cimento, Vol. 16, No. 3, 476-84 (May 1, 1960).

The mean free path for (200-300) MeV K^+-meson reactions emulsion nuclei (other than hydrogen) is found to be (60±6) cm. scatter from hydrogen in 92 m of track length is described and t data on elastic and inelastic reactions are given. No evidence of π-meson production was seen. The nuclear effects of the inelast reactions are discussed.

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15432 INTERACTIONS OF 125 MeV K^+ MESONS IN NUCLE EMULSION. O.R.Price, D.H.Stork and H.K.Ticho.

Phys. Rev., Vol. 119, No. 5, 1702-9 (Sept. 1, 1960).

An experimental study of the elastic, inelastic, and charge-exchange scattering of K^+ mesons in nuclear emulsion was made based on 100 metres of track at an average beam energy of 125 M The elastic scattering and total cross-sections were used in a di surface optical model calculation and the inelastic distribution w analysed by Monte Carlo techniques. With the assumption of S-w scattering for the T = 1 K^+—nucleon state and S- and P-wave scattering for T = 0, two best fit T = 0 phase-shift solutions are found for two different radius parameters. The dependence upon radius is small and the P-wave phase shifts seem to be importan this energy.

53

15433 LOW ENERGY KAON—NUCLEON REACTIONS. A.Komatsuzawa, R Sugano and Y Nogami.

Progr. theor. Phys., Vol. 21, No. 1, 151-73 (Jan., 1959).

Low energy KN and $\bar{K}$N reactions are investigated in the cas in which the kaon—nucleon—hyperon interaction is of the scalar with the nonrelativistic approximation. Direct interactions between kaons and pions are not considered. The higher-order effects of kaons and pions are examined in detail and their impor ance is emphasized. It is shown that, as far as the parameters a adjusted to fit the experimental data on the KN scattering, those the KN scattering can be hardly reproduced.

53

15434 THE PROBLEM OF THE Σ^-/Σ^+ RATIO IN K^-—p INTERACTION IN RELATION TO THE HYPOTHESIS O RESTRICTED SYMMETRY. M.L.Gupta.

Nuovo Cimento, Vol. 16, No. 4, 737-48 (May 16, 1960).

The problem of the Σ^-/Σ^- ratio has been discussed in the T^{-1} matrix formalism of Matthews and Salam (Abstr. 11838 of 19 Global symmetry being found to be incompatible with the Σ^-/Σ^+ even at threshold on the basis of new experimental data (Alvarez, Kiev Conference), consideration has been given to the restricted symmetry principle for explaining the behaviour of this quantity energy. It has been found that restricted symmetry is quite compatible with the experimental data on hyperon production ratios in the K^--meson—proton interaction. The difference in the phase-shifts in the scattering of the systems πY and πZ in states of "restricted symmetry isotopic spin" $\frac{1}{2}$ and $\frac{3}{2}$ is found to be -60^0 120^0, as first proposed by Gell-Mann. It has also been indicated t the conclusions about the restricted symmetry principle reached D'Espagnat and Prentki on the basis of old experimental data are reversed when the new experimental values are substituted in pla of the old ones, and the principle therefore remains quite a useful one for the interpretation of K^--meson—proton interaction phenomena.

539

15435 THE PHENOMENOLOGICAL REPRESENTATION OF $\bar{K}$—NUCLEON SCATTERING AND REACTION AMPLI TUDES. R.H.Dalitz and S.F.Tuan.

Ann. Phys. (New York), Vol. 10, No. 3, 307-51 (July, 1960).

An explicit parametrization of the $\bar{K}$—N scattering and reacti plitudes, satisfying the unitarity conditions and including the plications of time-reversal invariance, is given in terms of the ments of a suitably-defined reaction (or K-) matrix. Plausible proximations then lead to the formulae of a "zero-range" theory, extension of that introduced by Jackson et al., in which all the -energy $\bar{K}N$ cross-sections are expressed in terms of two comx scattering amplitudes (A_0, A_1), a phase angle ϕ_t and a real parater ϵ. The zero-energy and 175 MeV/c K^-—p data allow four ssible sets (a±), (b±) of these parameters; the Coulomb-nuclear erference in K^-—p scattering favours (a+) and (b+). The most portant qualitative conclusion based on this formalism is that the a indicates that the KYN coupling is so strong that perturbative thods are in general quite inadequate for the calculation of Krticle processes. The relationship of pion—hyperon (πY) scatter; cross-sections with the $\bar{K}N$ data is discussed in detail and it is own that the parameter sets (a–) or (b–) would require the existce of a πY resonant state not far below the K^-—p threshold. After termination of expressions for the $KN \rightarrow \pi Y$ amplitudes, the energy pendence of the Σ^-/Σ^+ and Λ/Σ^0 ratios are discussed, together with ne remarks on the $K^-p \rightarrow \Lambda\pi\pi$ cross-section. The Coulomb rrections to the nuclear K-matrix elements are derived, as well the modification of the corresponding T-matrix elements by the $-\bar{K}^0$ mass difference through the unitarity condition. These rrections are far from negligible and lead to appreciable modifiion of the parameter sets (a±), (b±). Each of these sets fits the $/\Sigma^+$ ratios at zero energy and in the range 100-200 MeV/c; the) and (b–) sets require a strong upward cusp in this ratio at the -n threshold, the (a–) and (b+) sets a downward S-shaped cusp. king all the present data together, the (a+) set appears favoured. brief discussion of the advantages and disadvantages of the Katrix formalism is given in the Appendix.

539.12

15436 ELASTIC AND INELASTIC SCATTERING OF NEGATIVE K-MESONS BY FREE PROTONS AT 90 MeV. H.Göing.

ovo Cimento, Vol. 16, No. 5, 848-60 (June 1, 1960). In German.

The total and differential cross-sections for elastic and inelastic attering of negative K-mesons from free protons for energies up 90 MeV in nuclear emulsions have been determined. The track ngth followed is 671.78 m. The differential cross-sections show at S-scattering suffices for the description of these processes and ulomb-scattering can be neglected for the angles considered 20°). A simple theory has been employed for the description of ese interactions and a phase-shift-analysis carried out for both ssible isotopic spin states T = 0 and T = 1. It turns out that sorption and shadow-scattering in the state T = 0 is greater than the state T = 1. The scattering length calculated here has been ed to calculate the cross-sections at high energies. They are in od agreement with the experimental values.

539.12

15437 EFFECT OF THE PION—PION RESONANCE ON K^-—p SCATTERING. F.Ferrari, G.Frye and M.Pusterla.

hys. Rev. Letters, Vol. 4, No. 12, 615-18 (June 15, 1960).

On the basis of the I = 1, J = 1 resonance in π—π scattering, it suggested that the K-meson charge structure has a sizeable conibution from this state. This enables the two-pion contribution to -wave K—N scattering to be estimated from the branch cut in the mplex plane. Expressions are given for the energy dependence of cot δ in terms of the contribution of the cut. Comparison with exeriment shows that the Coulomb interference in the angular distriation at 172 MeV/c must be constructive. Curves are given for is case of the energy dependence of the cross-sections and of the eal and imaginary parts of $(k \cot \delta)^{-1}$ for I = 1 and 0.

A.Ashmore

539.12

15438 A POSSIBLE EXPLANATION FOR THE MULTI-NUCLEON K^- CAPTURE.

Alexander, Y.Eisenberg and D.Kessler.

uovo Cimento, Vol. 15, No. 3, 484-6 (Feb. 1, 1960).

The multi-nucleon reaction is regarded as a two-step process itially the K^- is absorbed by a single nucleon to form a resonant —N state which then interacts with another nucleon to give the nal two-nucleon state. Some consequences of this model are educed, in particular the ratios between the various multi-nucleon eaction rates and their energy dependence. S.J.St-Lorant

539.12

15439 PHOTOPRODUCTION OF K^+ MESONS IN HYDROGEN.

H.M.Brody, A.M.Wetherell and R.L.Walker.

Phys. Rev., Vol. 119, No. 5, 1710-16 (Sept. 1, 1960).

The photoproduction of K^+-mesons in hydrogen was measured with the purpose of extending previous measurements (Abstr. 289 of 1958; 3797 of 1959) to smaller angles, and obtaining better absolute values for the cross-sections. The previous technique, using a magnetic spectrometer and a time-of-flight measurement to detect the K^+-mesons, was modified so as to achieve a better discrimination against pions and scattered protons. The results obtained are in fairly good agreement with the more extensive measurements made at Cornell by a somewhat different method (Abstr. 9000 of 1958; 382 of 1960).

539.12

15440 AN ESTIMATE OF THE CROSS SECTION FOR PRODUCTION OF POSITIVE K-MESONS BY ELECTRONS.

G.Zanmarchi.

Nuovo Cimento, Vol. 15, No. 3, 508-9 (Feb. 1, 1960).

The cross-section for the reaction $e^- + p \rightarrow e^- + \Lambda^0 + K^+$ is calculated using the method of Dalitz and Yennie (Abstr. 4778 of 1957). Using the value $(G/4\pi)^2 \cong 2.9$ for the K coupling constant, the calculated value is 3.65×10^{-33} cm^2 at 1022 MeV.

A.Ashmore

Hyperons

539.12

15441 GLOBAL SYMMETRY AND ISOTOPIC SPIN CONSERVATION IN NON-LEPTONIC HYPERON DECAYS. G.Takeda and M.Kato.

Progr. theor. Phys., Vol. 21, No. 3, 441-51 (March, 1959).

Possible existence of the universal $V \mp A$ coupling and the global symmetry in the non-leptonic hyperon decays is discussed. The observed deviations from the expected symmetries in actual decays are explained as effects due to the mesonic structure of hyperons. In a close relation with the idea of the global symmetry a new isotopic spin is defined, which is $\frac{1}{2}$ for all the baryons and integer for K. The conservation law of this isotopic spin is satisfied in the non-leptonic decays.

539.12

15442 THEORY OF Σ-HYPERON DECAYS.

S.Barshay and M.Schwartz.

Phys. Rev. Letters, Vol. 4, No. 12, 618-20 (June 15, 1960).

The Σ-hyperon is assumed to be a bound state of a Λ^0 and a pion, and the properties of the Σ decay into a pion plus a nucleon or into two leptons plus a nucleon are related to the properties of the Λ^0. The model suggests explanations of some of the observed features of Σ decay. E.J.Squires

539.12

15443 DECAY OF Σ-HYPERONS.

Chzhou Guan-Chzhao [Chou Kuang-Chao].

Zh. eksper. teor. Fiz., Vol. 38, No. 4, 1342-3 (April, 1960). In Russian.

It is suggested that a measurement of the polarization of the nucleons from the decay of $\Sigma^{\pm}$ produced in π—p collisions, can shed light on the validity of the $|\Delta I| = \frac{1}{2}$ rule for weak decays, and on the relation between the spinflip and nonspinflip amplitudes for the different charged decay modes of the Σ. R.F.Peierls

539.12

15444 ON THE $|\Delta I| = \frac{1}{2}$ RULE FOR THE DECAY OF Σ.

K.Itabashi.

Progr. theor. Phys., Vol. 19, No. 6, 747-8 (June, 1958).

Assuming the $|\Delta I| = \frac{1}{2}$ rule, expressions are found for the branching ratio of the Σ^+ decay, the ratio of the lifetimes of the Σ^- and Σ^+ decays and the asymmetry parameters of these decays. A possible analysis of the experimental data is then suggested which would allow a consistency check of the $|\Delta I| = \frac{1}{2}$ rule. J.S.Dowker

539.12

15445 THE ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF THE $\Sigma^{\pm}$-HYPERONS FORMED BY PROTONS IN A NUCLEAR EMULSION.

L.P.Dzhanelidze, K.V.Mandritskaya, O.A.Shakhulashvili, D.K.Kopȳlova, Yu.B.Korolevich, N.I.Petukhova, D.Tuvdendorzh,

Chzhen Pu-In [Cheng P'u-Ying] and N.I.Kostanashvili.
Zh. eksper. teor. Fiz., Vol. 38, No. 3, 1004-5 (March, 1960). In Russian.

Reports an investigation of the angular distribution of $\pi^\pm$-mesons from the decay of $\Sigma^\pm$-hyperons formed in a nuclear emulsion by 9 GeV protons. Assuming the distribution to have the form $(1 + a \cos\theta)$, where θ is the angle between the line-of-flight of the hyperon and the π-meson in a system at rest with the hyperon, 72 cases yielded an average value $a = 0.09 \pm 0.2$. If seven more cases were included (detected under slightly different conditions) this value became 0.03 ± 0.2. G.Martelli

539.12

15446

LIFETIMES, BRANCHING RATIOS, AND ASYMMETRIES IN Σ-HYPERON DECAYS.

S.C.Freden, H.N.Kornblum and R.S.White.
Nuovo Cimento, Vol. 16, No. 4, 611-24 (May 16, 1960).

Σ-hyperons produced by the capture of K^--mesons in nuclear emulsion have been studied. The mean lifetime of the Σ^+-hyperons which decay via the proton and π^+-meson modes has been measured. For the proton mode using 117 decays at rest and in flight it was found that $\bar{\tau}_{\Sigma^+\to p(\mathrm{all})} = (8.5^{+1.4}_{-1.1}) \times 10^{-11}$ sec. Using the 49 decays in flight only and the method of Maximum Likelihood, $\tau_{\Sigma^+\to p(\mathrm{flight})} = (9.5^{+18.7}_{-3.8}) \times 10^{-11}$ sec. For these decays the calculated lifetime is strongly dependent upon the measured Σ-hyperons energies. Both statistical and systematic errors tend to lower the measured lifetime. The lifetime calculated from 37 Σ^+ decays in flight into π^+ mesons is $\tau_{\Sigma^+\to\pi^+(\mathrm{flight})} = (6.0^{+6.8}_{-2.0}) \times 10^{-11}$ sec and is essentially unchanged when a cut-off of 5×10^{-11} sec is used. No evidence exists for a short-lived component. The following branching ratios have been found:

$$\frac{\Sigma^+ \to p + \pi^0}{\Sigma \to n + \pi^+} = 1.00 \pm 0.09 \quad \text{and} \quad \frac{\Sigma^+ \to p + \gamma}{\text{all } \Sigma^+} < 0.75\%$$

The values for the asymmetry parameters have been measured. When combined with previous data they are found to be $\alpha^0\bar{P} = -0.03 \pm 0.14$, $\alpha^+P = 0.03 \pm 0.16$ and $\alpha^-\bar{P} = -0.14 \pm 0.75$. The superscripts refer to the charges of the decay π-mesons.

539.12

15447

POSSIBLE INTERPRETATION OF AN UNUSUAL HYPERON DECAY.

C.M.Garelli, B.Quassiati and M.Vigone.
Nuovo Cimento, Vol. 16, No. 5, 960-2 (June 1, 1960).

The event is one in which a K^- interacts with an emuslsion nucleus producing four evaporation tracks, a π^- of 21 MeV kinetic energy which comes to rest and produces a star, and a hyperon which decays in flight. The charged decay product is a π^+ of 47 MeV kinetic energy that comes to rest and gives a $\pi^+ \to \mu^+ \to e^+$ decay. Ionization and scattering measurements give the hyperon mass as 1060 ± 210 MeV. Three interpretations are discussed:

(1) $K^- + n + p \to \pi^- + \Xi^0 + Y^+$ $(S = +1, Y = +2)$,
$Y^+ \to n + \pi^+$;

(2) Interaction of a $\Sigma^\pm$ hyperon;

(3) $\Sigma^+ \to \pi^+ + n + \gamma$.

The variant (3) is favoured, (1) is not inconsistent with the observations, and (2) is highly improbable. A.Ashmore

539.12

15448

THE NON-RENORMALIZATION HYPOTHESIS FOR THE VECTOR β-DECAY AND RARE DECAY MODELS [MODES] OF HYPERONS.

N.Cabibbo and R.Gatto.
Nuovo Cimento, Vol. 15, No. 1, 159-62 (Jan. 1, 1960).

Assuming a conserved vector β-decay current, the vector contribution to $\Sigma^\pm \to \Lambda^0 + e^\pm + \nu$ is related to the transition magnetic moment for $\Sigma^0 \to \Lambda^0 + \gamma$. With a value for the latter suggested by global symmetry, the branching ratio for the former is about 10^{-7}. Hence this process could only be detected if there were an anomalously large axial vector contribution. Alternatively, a measurement of this branching ratio would give a lower limit to the Σ^0 lifetime. R.J.N.Phillips

539.12

15449

THE ELECTRONIC DECAY OF Λ⁰ DERIVED INDIRECTLY BY K-MESON COUPLINGS.

D.Flamm.
Nuovo Cimento, Vol. 16, No. 1, 194-7 (April 1, 1960).

Calculates contributions to the $\Lambda^0 \to p + e^- + \nu$ decay rate, i lowest order, from indirect transitions via $Ke\nu$ and $K\pi e\nu$ couplir R.J.N.Phil

53

15450

NEW INTERPRETATION OF HYPERONIC CHARGE ITS GENERALIZATION TO LEPTONS.

T.Okabayas
Progr. theor. Phys., Vol. 20, No. 5, 583-613 (Nov , 1958).

All weak interactions are assumed to violate the conservati law of parity, contrary to the case of strong interactions. Such correlation between two conservation laws of parity and hyperon charge is expressed by the expectation value of a new operator $\zeta_2\gamma_5$. The nucleon and Ξ-particle are assumed as the eigenstate this operator, and two τ-spin doublets recombined from Λ- and particles are assumed as the eigenstates of $\zeta_3\gamma_5$, which anticomn with $\zeta_2\gamma_5$. If one assigns the suitable ζ-dependence to the tensor matrices associated with K- and π-mesons, the correlation menti above is arrived at. In the course of the construction of this sch the problems of the so-called particle mixture, and of the particl image under the coexistence of the parity-conserving and non-conserving interactions, are used as the stepping stones. The int duction of the new matrix ζ and the ζ-dependence of the tensor matrices associated with bosons allow one to assign the generali hyperonic charge to leptons, and to exclude the unwanted process $\pi \to e + \nu$, $(K \to e + \nu)$ and $p + \mu \to p + e$, owing to the assignment. The connection of this scheme and the interpretation that hyperor charge can be understood as the parity in isotopic spin space sug some internal correlation between the Minkowski space and the i topic spin space. The possibility of such correlation is discusse Finally, the spinor analysis in six-dimensional space, which part reproduces these phenomenologically obtained results, is describ as a tentative model.

539.

15451

ON THE DETERMINATION OF THE MAGNETIC MOMENT OF THE Λ⁰.

N.Schmitz.
Nuovo Cimento, Vol. 15, No. 4, 614-23 (Feb. 16, 1960).

In the presence of a magnetic field, the polarization vector o the Λ's from the reaction $\pi^- + p \to \Lambda^0 + K^0$, precesses about the field direction and the angular distribution of the decay pions will modified. The explicit expression of the angular distributions for several cases have been worked out in this paper. Some numeric data are given as to the magnitude of the effect which depends on field strength and the magnetic moment of the Λ^0. With the help c the theoretical formulae presented, the magnitude and the sign of Λ magnetic moment can be determined from the experimental distributions.

539.

15452

THE SIGMA–NEUTRON INTERACTION.

G.Eder.
Nuovo Cimento, Vol. 15, No. 1, 156-8 (Jan. 1, 1960).

Calculates the static potential due to the pion field, up to fourth order, following the Brueckner–Watson method. $NN\pi$, $\Sigma\Sigma$ and $\Sigma\Lambda\pi$ couplings are included, and the Σ–Λ mass difference is ignored. Putting all coupling constants equal, the singlet potentia is more attractive than the triplet one, which agrees with some experimental evidence. R.J.N.Philli

539

15453

SCATTERING AND RADIATIVE CAPTURE OF Λ-PARTICLES.

A.M.Kol'chuzhkin and N.N.Kolesniko
Zh. eksper. teor. Fiz., Vol. 38, No. 3, 996-7 (March, 1960). In Russian.

The magnitudes of the cross-sections for scattering and radiative capture of the Λ-particle by a nucleon at very low energ are calculated in a simple approximation. The latter process co petes unfavourably with the decay process. R.F.Peie

539.

15454

SIMPLE MODELS FOR ASSOCIATED PRODUCTION I PROTON–PROTON COLLISIONS.

E.Ferrari.
Nuovo Cimento, Vol. 15, No. 4, 652-7 (Feb. 16, 1960).

The process $p + P \to \Lambda^0 + K^+ + p$ is investigated by means of two simple models in which only the contribution of poles due to t exchange of an intermediate π^0-meson or K^+-meson respectively taken into account. The total cross-section is then calculated in terms of the total cross-sections for simpler processes. Numeri values are given for an energy of 3 GeV of the incident proton in t lab. system.

539.12

15455 **GENERATION OF A $\bar{\Sigma}^-$-HYPERON FROM NEGATIVE π^--MESONS WITH MOMENTUM 8.3 BeV/c.**
an Gan-Chan [Pang Kang-Chang], Van Tsu-Tszen [Pang Tsu-Tseng], .I.Veksler, N.M.Viryasov, I.Vrana, Din Da-Tsao [Ting Ta-Ts'ao], im Khi In, E.N.Kladnitskaya, A.A.Kuznetsov, A.Mikhul, guen Din Ty, A.V.Nikitin and M.I.Solov'ev.
h. eksper. teor. Fiz., Vol. 38, No. 4, 1356-9 (April, 1960). In ussian.

The discovery of this antiparticle is reported. The event in hich it was generated has been found amongst 40 000 pictures btained with a propane bubble chamber provided with a magnetic eld of 13 700 Oe. A reproduction of the photograph of the event is iven, together with a full discussion of the energy balance of all he particles involved. G.Martelli

539.12

15456 **DISPERSION RELATIONS FOR PION—HYPERON PRODUCTION AND A POSSIBLE PION—HYPERON ESONANCE.** R.H.Capps.
hys. Rev., Vol. 119, No. 5, 1753-62 (Sept. 1, 1960).

Approximate P-wave dispersion relations are derived, but not proved, for the processes $\bar{K} + N \to \pi + \Sigma$ (or Λ) under the assumption that all pion—baryon and K—baryon interactions are of the odd intrinsic-parity, Yukawa type. By comparing these equations with the analogous equations for pion—hyperon scattering, it is shown that a low-energy resonance is likely to occur in a particular combination of the isotopic spin one, $P_{3/2}$, $\pi + \Lambda$ and $\pi + \Sigma$ scattering states, and this resonance should be recognizable in the π + Y production processes. Despite complications associated with the unphysical region in the π + Y production dispersion relations, and with the fact that the K interactions are moderately strong, the resonance should occur in the production process in a direct and simple way. Measurements of the cross-section for production of this resonance state can give information about the strengths of the strong interactions, particularly the pion—baryon interactions. The present experimental evidence concerning the existence of such a resonance effect in π + Y production is favourable, but inconclusive. A short discussion is given of the additional experimental information needed to test the resonance hypothesis.

trange particles

539.12

15457 **ON A NEW STRANGE PARTICLE.**
B.Pontekorvo [Pontecorvo].
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1654-6 (May, 1960). In Russian.

A method is proposed of investigating the existence of a hypothetical new strange particle (D-particle) of mass ~ 750 MeV, decaying very rapidly into a K-meson and a pion. The method involves the search for K-mesons coming from the decay which can be identified as originating near a target bombarded by high-energy particles and distinguished from K-mesons originating in the target. R.F.Peierls

539.12 : 539.11

PARTICLE MIXTURE OF STRANGE PARTICLES. See bstr. 15299

eutérons

539.12

15458 **PROPERTIES OF NUCLEAR FORCES INDICATED BY d(γ,p)n.** Shih-Hui Hsieh.
Progr. theor. Phys., Vol. 21, No. 1, 185-206 (Jan., 1959).

For previous work, see Abstr. 6895 of 1957; 9444 of 1960. A repulsive property of ^1E, and the strong tensor forces of ^3O and ^3E, are pointed out (^1E, ^3O and ^3E represent the singlet even, the triplet odd, and the triplet even states respectively). The detailed forms of the potentials are discussed. Comparison with nucleon—nucleon scattering is made. Also the applicability of the pion theoretical potential is investigated, and it is shown that its applicability is quite good.

539.12

15459 **THE REACTION $d + d \to \pi^0 + He^4$ AT A DEUTERON ENERGY OF 400 MeV.**
Yu.K.Akimov, O.V.Savchenko and L.M.Soroko.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 304-6 (Jan., 1960). In Russian.

Preliminary measurements performed with a deuteron beam of 400 MeV and fast electronics, yield a value for the total cross-section $\sigma_t < 1 \times 10^{-31}\,cm^2$ which does not contradict theoretical predictions based on the hypothesis of conservation of total isotopic spin. Since in the same experiment the occurrence of the reaction $d + d \to \pi_0^0 + He$ could also have been detected if it had been present, the low value found for σ_t suggests that the isotopic scalar π_0^0 meson does not exist. One point of the differential cross-section for the reaction $d + d \to He^3 + n$ at 15.5° in the centre-of-mass system has also been measured and a value of $(3.8 \pm 0.5) \times 10^{-29}\,cm^2$/sterad has been found. G.Martelli

539.12

15460 **DEUTERON PHOTODISINTEGRATION IN THE MEDIUM ENERGY RANGE.** G.Kramer and C.Werntz.
Phys. Rev., Vol. 119, No. 5, 1627-31 (Sept. 1, 1960).

The photodisintegration of the deuteron is calculated for the two γ-ray energies in the laboratory of 52.3 and 77.3 MeV corresponding to nucleon—nucleon scattering in the laboratory of 100 and 150 MeV. For the ground state the Hulthén wave-function with 4% D-state probability is used. The final state is described by the Signell—Marshak phase shifts. The coupling of the scattered waves is taken into account, as well as the retardation effects and all dipole and quadrupole transitions are included. For unpolarized γ-rays the total cross-section and the angular distribution are calculated. A comparison with experiment is made.

Tritons

539.12

15461 **INTERACTION OF 6- TO 14-MeV DEUTERONS WITH HELIUM THREE AND TRITIUM.**
L.Stewart, J.E.Brolley, Jr, and L.Rosen.
Phys. Rev., Vol. 119, No. 5, 1649-53 (Sept. 1, 1960).

The angular distributions of the cross-sections for the $T(d,n)He^4$ and $He^3(d,p)He^4$ reactions were measured at five incident deuteron energies between 6 and 14 MeV. The data were fitted with Legendre expansions. A search for excited states in He^4 near 22 MeV and for evidence of the formation of H^4 gave negative results.

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59 : 538.1

15462 **MODEL EXPERIMENTS ON THE DESIGN OF SOLID IRON MAGNETS FOR USE IN COSMIC RAY SPECTROGRAPHS.** H.W.Bennett and W.F.Nash.
Nuovo Cimento Suppl., Vol. 15, No. 2, 193-201 (1960).

The high magnetic field available in a magnetized block of iron may be used to measure the momentum of non-interacting particles such as μ-mesons, provided that the line integral of the magnetic induction is known with sufficient accuracy. Model "picture frame" magnets were constructed in order to investigate the effects of geometry and of degree of magnetization on the uniformity of the magnetic induction. The relative merits of passing the particles through the energizing coils or the open ends are considered. It is found that high inductions, with uniformity of ±3%, may easily be obtained over 90% of the available volume for comparatively low power dissipation.

537.59 : 538.1

15463 **THE CHARACTERISTICS OF A SOLID IRON MAGNET FOR USE IN A COSMIC RAY SPECTROGRAPH.**
P.V.O'Connor and A.W.Wolfendale.
Nuovo Cimento Suppl., Vol. 15, No. 2, 202-10 (1960).

Many advantages are gained by deflecting weakly interacting cosmic-rays in magnetized iron instead of the conventional air gap of an electromagnet. A solid iron magnet has been constructed in the form of a rectangular transformer core with excitation windings on opposite sides of the core. The design is based on the results of model experiments by Bennett and Nash (preceding abstract) on the variation of induction throughout the iron and the leakage field above and below the magnet. When the magnet is operated at a power of 2 kW (mean $\int B\,dl$ = 982 kG cm), the variation of integrated magnetic induction for vertical particle trajectories, is less than ±3%.

537.59

15464 ON THE UNUSUAL INCREASE AND THE MODULATION OF COSMIC RAYS.

K.Kawabata, I.Kondō, K.Murakami and M.Wada.
Rep. Ionosphere Res. Japan, Vol. 11, No. 4, 229-47 (Dec., 1957).

The intensity variations at the time of the unusual increase of cosmic rays on Feb. 23, 1956 are studied. Considering the large cosmic-ray intensity decrease which preceded the increase, the shape of the disturbed region occupied by the magnetic clouds is postulated. From the shape and the physical conditions of the disturbed region, the following processes can be imagined. The particles emitted from the sun travel through the outer field-free space and enter the disturbed region from the boundary. The particles which enter from the nearest boundary to the earth and suffer only a small scattering may reach the earth earlier and cause the increase at the prompt onset region. On the other hand, these clouds may scatter out particles which travel through the region from the sun and prohibit them reaching the earth. As it is reasonable to assume that the earth is situated in the region and near its eastern boundary, the large extension and the eastern shift of the apparent source area for the prompt onset region can be explained. The other particles which are scattered and stored by the magnetic clouds reach the earth at a later time nearly isotropically. Also the storage of the particles by this region explains the slow decay ($T^{-3/2}$)of the increased intensity. Some detailed calculations on the transfer of the particles in this region confirm this picture.

537.59

15465 CORPUSCULAR RADIATION EXPERIMENT OF SATELLITE 1959 IOTA (EXPLORER VII).

G.H.Ludwig and W.A.Whelpley.
J. geophys. Res., Vol. 65, No. 4, 1119-24 (April, 1960).

Satellite 1959ι (Explorer VII) carries an apparatus prepared by the Department of Physics and Astronomy of the State University of Iowa for comprehensive spatial and temporal monitoring of total cosmic-ray intensity, geomagnetically trapped corpuscular radiation, and solar protons. In view of the sucessful operation of the equipment during the first 2 months of flight and the expectation of its continued operation until October 1960, international participation in the recording and interpretation of the radiation observations was invited. A full description of the apparatus is given, including detector calibrations, telemetry code, samples of actual recordings, and other pertinent information.

537.59 : 525

RADIATION INFORMATION FROM $1958\delta_2$. See Abstr. 14477

537.59 : 551.5

BALLOON STUDY OF HIGH-ALTITUDE RADIATIONS DURING THE INTERNATIONAL GEOPHYSICAL YEAR. See Abstr. 14266

537.59

15466 EFFICIENCY OF ACCELERATION OF RELATIVISTIC PARTICLES IN THE CRAB NEBULA.

S.Hayakawa and Y.Terashima.
Progr. theor. Phys., Vol. 18, No. 5, 555-7 (Nov., 1957).

It is suggested that the expanding remnant of a supernova may provide an efficient source of high energy cosmic-ray particles. The suggestion is supported by a consideration of the energy production and consumption in the Crab nebula. R.A.Newing

537.59

15467 CLOUD CHAMBER EVIDENCE FOR THE PRESENCE OF SIMULTANEOUS HIGH ENERGY NUCLEAR-ACTIVE PARTICLES AT MOUNTAIN ALTITUDES.

S.Naranan, R.Raghavan, P.V.Ramanamurthy, B.V.Sreekantan and A.Subramanian.
Nuovo Cimento, Vol. 16, No. 3, 401-11 (May 1, 1960).

In an examination of 22000 pictures of penetrating showers recorded with a multiplate cloud-chmaber (60 cm × 60 cm × 20 cm), in a time of operation of 5310 hr, at an altitude of 2.2 km, 32 cases have been obtained in each of which two or more simultaneous pa lel high-energy nuclear-electromagnetic cascades (~100 GeV) a seen developing in the plates. The visible energy of the individu cores has been determined by the track length method. It is fou that in most of the cases the visible energies of the parallel casc in a picture are of comparable magnitude. The separation betw the cores ranges from 5 to 40 cm, and the corrected distribution looks flat. There is clear indication that about half of the events associated with dense air showers. The "unassociated" events a interpreted in terms of local nuclear interactions of particles of energy ≥ 450 GeV in air up to a height of 140 m above the apparat The "associated" events are explained as being parts of air show containing about 100 nuclear-active particles of energy ≥ 100 Ge near the core.

537

15468 THE ENERGY SPECTRUM OF NUCLEI WITH CHARG Z ≥ 6 IN THE PRIMARY COSMIC RADIATION.

S.Biswas, P.J.Lavakare, K.A.Neelakantan and P.G.Shukla.
Nuovo Cimento, Vol. 16, No. 4, 644-70 (May 16, 1960).

The "knock-on electron" technique was employed to determi the energy spectrum of nuclei with charge Z ≥ 6 in the primary c mic radiation. In this technique the energy per nucleon of a heavy primary cosmic-ray nucleus is determined by measuring the angl emission and the energies of electrons which the nucleus "knocks in elastic collisions along its path in traversing nuclear emulsion. Since the energies of the knock-on electrons are relatively small (<100 MeV in this experiment), they can be measured with precisi by the method of multiple Coulomb scattering. The conditions for reliable estimation of primary energy have been determined and t reliability of the method verified by comparison with results obtai by other methods. The charges and energies of the particles have been determined in the following two ways: (1) for particles which are arrested in the emulsion, from measurements of range and δ-ray density; (2) for particles which do not stop, from measurem of δ-ray density and of the energies and the angles of emission of fast knock-on electrons; in the few cases where the particle slowe down in traversing the stack, the variation of δ-ray density along track was determined. Measurements were made on 291 tracks o tained in a stack flown from Iowa ($\lambda = 53^\circ$N), at 113 000 ft for four hours on March 13, 1956. 206 of these tracks were due to particle with charge Z ≥ 6. The exponent of the integral energy spectrum the medium (6 ≤ Z ≤ 9) group of nuclei has been obtained as 1.65 ± 0.27 in the energy range 0.23 to 9 GeV/nucleon and that of t heavy (Z ≥ 10) group of nuclei as 1.82 ± 0.59 in the energy interva 0.41 to 9 GeV/nucleon. The exponent for the S-group of nuclei (Z ≥ 6) is then 1.78 ± 0.24. The geomagnetic cut-off energy at $\lambda = 54.5^\circ$N has been estimated to be 230 MeV/nucleon. The values the flux of M and H-nuclei were found to be 10.7 ± 1.0 and 5.3 ± 0. particles m^{-2} sec^{-1} $sterad^{-1}$ respectively (on March 13, 1956). A comparison of these values with those obtained in other experiment shows that a Forbush type of decrease had taken place in the intens of the heavy nuclei, similar to that observed by McDonald in the α-particle flux on the same flight; neutron monitors on ground had also recorded a Forbush decrease at the same time.

537.

15469 ON THE RELATIVE ABUNDANCE OF CARBON, NITROGEN AND OXYGEN IN THE COSMIC RAYS.

C.Q.Orsini.
Nuovo Cimento, Vol. 16, No. 6, 1040-5 (June 16, 1960).

Plates (33 G-5 emulsions) were exposed at an atmospheric depth of approximately 6 g/m^2. Gap length measurements of 220 medium nuclei have these ratios C : N : O : : 1.5 : 0.97 : 1.0. Usin different parameters in the diffusion equation it was not possible t obtain agreement with the values of Suess and Urey's cosmic abundances. The results indicate that the chemical composition of the sources of cosmic rays is different from the mean composition of the Universe.

537.5

15470 ANALYSIS OF METHODS OF MEASURING THE γ COEFFICIENT OF EXTENSIVE COSMIC-RAY SHOWERS.

R.Firkowski and A.Zawadzki.
J. Phys. Radium, Vol. 20, No. 4, 456-61 (April, 1959). In French.

The formal analysis of the two measurement methods of the γ exponent, (a) by variation of the order of the coincidence, (b) by variation of the area of the counter trays, shows that they are not complementary independently of the existence of the density gradient in the horizontal section of the extensive air shower. The presence of the density gradient causes an apparent increase of the γ value determined by method (a). By using a hodoscopic arrangement ich allows one to record simultaneously three, four, five and fold coincidences it can be shown that the γ value obtained by thod (a) is higher than the value obtained by method (b), and that the ue increases with the order of coincidence. All the conclusions ve been based on a single set of measurements of 124 000 coincince records. By using an appropriate computing method all ssible recording combinations have been taken advantage of; this s possible due to the transition from coincidences of a given der to coincidences which are at least of the given order (e.g. m threefold coincidences to at least threefold coincidences). is fact considerably reduces the statistical errors.

537.59

15471 CLOUD CHAMBER STUDY OF EXTENSIVE AIR SHOWERS.

T.Gémesy, T.Sándor and A.Somogyi.

uovo Cimento, Vol. 16, No. 3, 412-15 (May 1, 1960).

Measurements were carried out by means of a multi-plate oud chamber controlled by an extensive air shower arrangement order to check the authors' earlier results concerning the ansition effect of the extensive air showers as well as to deterine a more precise value of the photon/electron ratio.

537.59

15472 ON THE N-COMPONENT IN EXTENSIVE AIR SHOWERS.

D.S.Narayan and G.B.Yodh.

uovo Cimento, Vol. 16, No. 6, 1020-39 (June 16, 1960).

According to Nikolskij et al. (1957), the number of nuclearctive (N) particles in air showers increases fairly slowly, as $E^{0.2}$, r showers ranging in energy from 10^{13} eV to 10^{15} eV. At energies 0^{15} eV the increase is more rapid and is $\propto E$. This variation in e N-component with the size of the shower and certain other bserved features of air showers have been interpreted previously s an indication of a change in the nature of nuclear interactions at ery high energies or as an indication of specific details in the ature and composition of the primary cosmic radiation, such as the xistence of a cut-off in the magnetic rigidity of the particles and e predominance of heavy primaries at very high energies. In this aper an attempt is made to explain the observed features in terms f certain characteristics of nucleon—nucleus (n—N) pion—nucleus π—N) collisions; the term "nucleus" here refers to an "air ucleus". The main aspect of the (Nikolskij) curve, for the abundance f N-particles versus shower energy, considered here, is not the apid increase of the N-component in showers of energy $> 10^{15}$ eV, or the existence of a change in the abundance of N-particles in oing from small showers to big showers, but rather the fairly slow ncrease in the number of N-particles in showers of energy 10^{13}-10^{15}) eV. This slow increase, which is contrary to general xperience in cascade calculations, puts stringent limitations on the hoice of parameters that characterize n—N and π—N collisions. t is shown that n—N and π—N collisions are largely elastic and that he number of secondary nucleons produced in such collisions is uite small (of the order of one or two); further, in a π—N collison, e energy going into the nucleon component is a very small fraction f the energy of the incident pion. These features also result in a apid increase in the N-component of big showers; this arises as a esult of the complicated role played by charged pions owing to their inite life time. In small showers the charged pions have only small nergies and hence they mostly decay and do not contribute appreciably, to the N-component. In big showers, however, the pions have ufficiently high energy to make nuclear interactions before decaying nd owing to the large multiplicity of pions produced in n—N and —N collisions, there is a rapid increase in the number of Narticles with increasing energy of the shower. Some experiments re suggested to distinguish between the various possible explanations.

537.59

15473 THE LATERAL DISTRIBUTION OF THE ELECTRON COMPONENT IN EXTENSIVE AIR SHOWERS.

.Ueda and N.Ogita.

rogr. theor. Phys., Vol. 19, No. 5, 582-5 (May, 1958).

The quantitative effect of the inelasticity at high-energy nuclear ollisions on the lateral distribution of the electron component in xtensive air showers is examined. C.F.Barnaby

537.59

15474 AN ANALYSIS OF EXPERIMENTAL DATA ON EXTENSIVE AIR SHOWERS.

S.Miyake.

rogr. theor. Phys., Vol. 20, No. 6, 844-56 (Dec., 1958).

Fluctuations in the starting points of extensive air showers in the atmosphere are analysed. A method of obtaining the shower curve without taking into account the effect of the fluctuations is presented. The latter effect results in small-energy showers which thrust themselves into the lower atmosphere being observed as if they were large-energy showers, and the effect is not insignificant especially in the case of observing showers of large size at low altitudes. This may also modify the primary energy spectrum in such a way that the intensity at very high energies is significantly smaller than the one currently adopted. Qualitative interpretations of some unusual events and some speculations on high-energy nuclear interactions are also given.

537.59

15475 A NUCLEONIC CASCADE THEORY AND AN ANALYSIS OF EXTENSIVE AIR SHOWERS.

H.Fukuda, N.Ogita and A.Ueda.

Progr. theor. Phys., Vol. 21, No. 1 29-73 (Jan., 1959).

A model of extremely high-energy nuclear collisions which describes Landau's model approximately or satisfies the constancy of transverse momenta of secondary particles as special cases is applied to the nucleonic cascade process in the atmosphere. The model contains some free parameters which specify the dynamical character of the nuclear collisions. The fact that the diffusion equation is solved analytically in a rather simple form on certain assumptions makes it easy to find the best values of the parameters by comparing with experimental information if available. Applications to extensive air showers are presented. The main results obtained are as follows. (a) If the energy spectrum of secondary charged pions at a high-energy collision is well approximated by a power law spectrum $E^{-n}dE$, $2 \gtrsim n \gtrsim 1.5$ is consistent with the lateral distribution of high-energy muons far underground. (b) Any model in which the energy spectrum, the inelasticity, the ratio of charged-to-neutral pions are independent of incident energy in a wide range of $10^{12} \sim 10^{17}$ eV seems unable to explain the altitude variation of the electron component. (c) The lateral distribution of the electron component is insensitive to the energy spectrum of neutral pions at high-energy collisions and also to the primary energy. Further discussion on this model and the solution of the diffusion equation are given.

537.59

15476 ON THE SPECTRUM OF THE ELECTRON-PHOTON COMPONENT OF EXTENSIVE AIR-SHOWERS.

I.A.Ivanovskaya and I.V.Rakobol'skaya.

Zh. eksper. teor. Fiz. Vol. 35, No. 6(12), 1583-4 (Dec., 1958). In Russian. English translation in Soviet Physics—JETP (New York), Vol. 35(8), No. 6, 1107-8 (June, 1959).

Earlier observations of extensive air-showers by means of a cloud-chamber with lead plates (Abstr. 1759, 7151 of 1958) have been repeated to investigate discrepancies. An analysis of 385 showers whose axes were in 70% of the cases within 3 m of the chamber yields an energy spectrum which differs from that of the first reference below 10^9 eV. In agreement with the second experiment the fraction of electrons and photons with energies exceeding 10^9 eV was found to be 12 ± 3%. The reasons for the discrepancies with earlier results are discussed. E.G.Michaelis

537.59

15477 RATE OF EXTENSIVE AIR SHOWERS OF COSMIC RAYS NEAR SEA LEVEL.

S.I.Mishnev and S.I.Nikol'skii.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 257-8 (Jan., 1960). In Russian.

The density spectrum of cosmic-ray showers was measured by means of four counter trays placed a few metres apart at the vertices of an equilateral triangle with a tray at the centre. The results are given in two graphs. G.Martelli

537.59

15478 SPATIAL DISTRIBUTION OF CHARGED PARTICLES IN INDIVIDUAL EXTENSIVE AIR SHOWERS.

S.N.Vernov, N.N.Goryunov, V.A.Dmitriev, G.B.Kulikov, Yu.A.Nechin and G.B.Khristiansen.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 297-8 (Jan., 1960). In Russian.

Reports a study of individual showers by means of an arrangement of Geiger counters connected to a hodoscope and of a core detector consisting of two groups of ionization chambers. One of the two groups, covered with lead, allows a detailed analysis of the shower cores within the dimensions of each chamber (25 cm). The counters are placed around the core detector, up to 25 m from it. 26 showers with $N \geq 10^5$ were investigated and an analysis is given in terms of the cascade parameter S, as defined in the theory of

Nishimura and Kamata. The statistical agreement is checked with the Pearson criterion. The results show that at sea level there exist showers at different stages of their development. G.Martelli

537.59

15479 ON CURTAIN SINGULARITIES IN THE INTERACTION WITH LIGHT NUCLEI OF PARTICLES WITH ENERGIES $E \geq 2 \times 10^{12}$ eV. N.L.Grigorov and V.Ya.Shestoperov.
Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1147-9 (Oct., 1959). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 37(10), No. 4, 816-18 (April, 1960).

Cascade showers were detected in a pulse ionization chamber array 3.3 in. square. Events were selected with a soft-component energy $\geq 2 \times 10^{12}$ eV and with 70% of the ionization in a circle 20 cm in diameter. This restricted the production region to an atmospheric layer ~ 100 g/cm^2 thick above the array. Nuclear interacting particles were detected in a layer of C 60 g/cm^2 thick followed by a further chamber array. They were detected in only 30% of the events indicating a high probability for transfer of the entire energy of the primary particle to the soft component. Such events were accompanied by a weak extensive air shower indicating additional weak interactions of higher probability. A.Ashmore

537.59

15480 ON THE MOMENTUM SPECTRUM OF PARTICLES IN COSMIC RAY JETS.
J.Pernegr, V.Šimák and M.Votruba.
Nuovo Cimento, Vol. 17, No. 2, 129-33 (July 16, 1960).

It is shown that the form of momentum spectrum of jet particles is essentially dependent on the degree of anisotropy of the angular distribution, and that, for example, the form dp/p^2 corresponds to a definite "medium" anisotropy. Integral spectra of directly measured values of p indicate a systematic decrease of transversal momenta in the vicinity of the axis and of the $\pi/2$-plane in c.m. system.

537.59

15481 ON THE UNUSUAL INCREASE OF COSMIC-RAY INTENSITY ON FEBRUARY 23, 1956. M.Kitamura.
Rep. Ionosphere Res. Japan, Vol. 11, No. 2, 55-9 (June, 1957).

The data associated with the increase are analysed and interpreted in terms of a model in which the whole of interplanetary space in the solar system is filled with low-density magnetized matter. It is then found that the main features of the propagation of the flare particles through the disordered magnetic field of interplanetary matter can be described by a diffusion equation. In particular the sharpness of the maximum as a function of time is better represented on this model, than on the model with a central field-free cavity proposed by Meyer et al. (Abstr. 2387 of 1956). J.W.Gardner

537.59

15482 COSMIC RAY INCREASE ASSOCIATED WITH A SMALL SOLAR FLARE.
P.S.Gill, L.Vir, R.S.Yadav and M.K.Khera.
Indian J. Meteorol Geophys., Vol. 11, No. 2, 169-70 (April, 1960).

This was observed on 19 June 1958 at the Gulmarg Research Observatory (9000 ft, geomagnetic latitude 24°.7 N) with a standard meson cubical telescope and narrow angle telescopes.

537.59

15483 CHANGES IN THE LOW-RIGIDITY PRIMARY COSMIC RADIATION DURING THE LARGE FORBUSH DECREASE OF MAY 12, 1959. F.B.McDonald and W.R.Webber.
J. geophys. Res., Vol. 65, No. 2, 767-70 (Feb., 1960).

Details are given of the data obtained during the large Forbush decrease of May 12, 1959 with particular reference to the rigidity and composition of primary cosmic-ray particles. Information was obtained during this period from two balloon flights using a Lucite Cherenkov detector and a NaI scintillation crystal. The simultaneous measurement of outputs from the two detectors allows a direct determination of the charge and velocity of the incident particles. The results show that the Forbush decrease was indistinguishable in its effects on low-rigidity cosmic-ray protons and alpha-particles from the effects of the long-term variation which was monitored with identical detectors over the preceding four years. It is not implied that the two types of changes are caused by the same mechanisms but that the end results appear to be the same in the low-rigidity region. C.F.Barnaby

53

15484 RECOVERY OF COSMIC-RAY INTENSITIES AFTER THE "FORBUSH-TYPE DECREASE". T.Yagi.
J. Geomagn. Geoelect., Vol. 11, No. 1, 11-20 (1959).

By use of Chree's superposed-epoch method, investigation w made of the recoveries of cosmic-ray intensities, horizontal cor ponents of geomagnetic field and sunspot areas following remark "Forbush-type decrease." (1) Cosmic-ray intensities and horiz components of the geomagnetic field show recovery curves whicl resemble each other, but the curve of sunspot areas remains as lower level than those of the former two. (2) Cosmic-ray intens show an exponential recovery until the 26th day, with 14.7 days n life. On the other hand, sunspot areas show such recovery until the 11th day, with 7.3 days mean life. (3) On the recovery-curve of logarithms of cosmic-ray intensity decrements, there exists a knee at the 4th day. It is proposed as an assumption that this kn corresponds to the escape of the earth out of the corpuscular str ejected from the sun.

53

15485 COSMIC-RAY CHARACTERISTICS REGISTERED IN CHACALTAYA DURING UNUSUALLY HIGH SOLAR ACTIVITY. I.Escobar, E.Maldonado, N.W.Nerurkar and R.Rome
J. geophys. Res., Vol. 65, No. 5, 1385-90 (May, 1960).

Cosmic-ray meson intensity at Chacaltaya (elevation 5220 m above sea level and magnetic latitude 4° S) registered a 9.5% decrease during three magnetic storms of July 1959. In addition a small increase of 1 to 2% was observed in association with the first and last storms which commenced at Chacaltaya at about noon. These features have been discussed in relation to different magnetic field structures contained in the ionized gas ejected by the sun, and it is shown that the gas had partly turbulent and partl coherent magnetic fields in it when it arrived in the earth's vicinity.

537.

15486 27-DAY RECURRENCE OF COSMIC-RAY INTENSITY AT THE MINIMUM SOLAR ACTIVITY. M.Kodama.
J. Geomagn. Geoelect., Vol. 11, No. 1, 6-10 (1959).

There exists a close negative correlation between the 27-day recurrence tendency of cosmic rays and that of solar activity. B recurrences have, however, a positive correlation during several months at the minimum solar activity. This phenomenon suggests that there may be solar emission of cosmic-ray particles at all times, which is not observable except during the short period of minimum solar activity.

537.

15487 COSMIC RAY INVESTIGATIONS WITH AN AIRBORNE NEUTRON MONITOR.
M.A.Pomerantz, V.R.Potnis and S.P.Agarwal.
Nuovo Cimento, Vol. 16, No. 3, 469-75 (May 1, 1960).

A neutron monitor has been in operation aboard a magnetic su vey aircraft. During a cruise in November, 1958, the latitude eff of the nucleonic component was measured over the same route between Tokyo and the Aleutian Islands as that covered by Sandström in February, 1957. Although the two sets of data normalized at Tokyo are in agreement up to approximately 43° N (modified geomagnetic latitude), a change in the shape of the curve had occurre at higher latitudes. The intensity at 55° N had decreased by 13%, a the "knee" had shifted from 47° N to 43° N. The latitude variation o the absorption mean free path was determined from intensity vers altitude curves at geomagnetic latitudes 50° N, 37° N, 25° N, and 13° A change of roughly 10% over a range of primary cut-off rigidity from 2 GV to 15 GV was indicated. Comparison with earlier result of others revealed no appreciable variation of the mean free path during the solar cycle.

537.

15488 METEOROLOGICAL COEFFICIENTS AND SOLAR DAILY VARIATION OF THE COSMIC RADIATION MEASURED UNDERGROUND. T.Sándor, A.Somogyi and F.Telbisz
Nuovo Cimento, Vol. 17, No. 1, 1-7 (July 1, 1960).

The authors have been registering the intensity of the penetrating component of the cosmic radiation since February 1958. Th absorption and decay coefficients as well as the total barometric coefficient were determined from the data of the first year of the observation. The amplitude of the fluctuation of the primary radiation was also determined for each month and together with the amplitude of the solar daily variation.

537.59

15489 GEOMAGNETIC LATITUDE EFFECT OF THE COSMIC-RAY NUCLEON AND MESON COMPONENTS AT SEA EVEL FROM JAPAN TO THE ANTARCTIC.

.Kodama and Y.Miyazaki.
ep. Ionosphere Res. Japan, Vol. 11, No. 3, 99-115 (Sept., 1957).

Measurements of cosmic-ray nucleon and meson components ere made from Japan to the Antarctic on the ice-breaker "Sōya", ring the period from November, 1956 to April, 1957. Latitude fects of 60% for the nucleon component and 12% for the meson com- nent were obtained. The knee of the latitude curve was found at out the same geomagnetic latitude of 35° S for both components. e geomagnetic cut-off rigidity of the particles arriving from the rtical at this latitude is 6.4 Bv. Comparing the latitude effects tained by the authors with Simpson's results, it was found that the gher the latitude, the difference between cosmic-ray coordinates d the geomagnetic coordinates becomes smaller. A typical cosmic-y storm and the diurnal variations at 69° S geomagnetic, were udied, the latter having some difficult features to interpret, com-red with the results at other latitudes.

537.59 : 550.3

15490 COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. I. THE COSMIC AY EVENTS AND THEIR CORRELATION WITH THE GEOMAG-ETIC EVENTS.

.Bachelet, P.Balata, A.M.Conforto and G.Marini.
uovo Cimento, Vol. 16, No. 2, 292-319 (April 16, 1960).

Cosmic-ray storms (CRS), i.e. world-wide decreases of the osmic-ray intensity as measured by standard neutron monitors in ome and in other parts of the world, were systematically investi-ated during the period July, 1957-July, 1958, in correspondence ith magnetic storms (MS). The correlations CRS → MS and S → CRS were examined. The characteristic features of both lasses of events were considered in order to find out which of them ere preferential for the association itself. Some aspects of the orrelation were approached by statistical method.

537.59 : 550.3

15491 COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. II. THE GEOMAG-ETIC EVENTS.

F.Bachelet, P.Balata, A.M.Conforto and G.Marini.
uovo Cimento, Vol. 16, No. 2, 321-31 (April 16, 1960).

The magnetic storms occuring in the period July, 1957-July, 1958 are selected and classified in view of an analysis of their orrelation with cosmic-ray storms. The methods and the criteria employed are described in detail. A list of all geomagnetic events thus identified is reported.

537.59

15492 COSMIC RAY CUT-OFF RIGIDITIES AND THE EARTH'S MAGNETIC FIELD.

J.J.Quenby and W.R.Webber.
Phil. Mag. (Eighth Ser.), Vol. 4, 90-113 (Jan., 1959).

Approximate values of the vertical cut-off rigidities for cosmic ray particles in the earth's magnetic field have been deduced taking into account both the dipole and the non-dipole parts of the internal field. The accuracy of these calculated values is discussed and it is shown that they fit the experimental data rather well.

537.59

15493 ON THE CONTINUOUS OBSERVATION OF COSMIC-RAY INTENSITY BY THE STANDARD NEUTRON AND MESON MONITORS.

Y.Miyazaki.
Rep. Ionosphere Res. Japan, Vol. 9, No. 1, 17-19 (March, 1957).

Describes the instrumental, shielding and geometrical arrangements for a neutron monitor and meson monitor, located respectively at Mt. Norikura (36° 06' N, 137° 30' E, geomag. lat. +25° 40'; 2840 m) and at Tokyo (35° 45' N, 139° 43' E, g. lat +25° 30'; 20 m). Typical records and counting statistics are given for a period in January, 1957.
J.W.Gardner

537.59

15494 ON THE UNUSUAL INCREASE OF COSMIC-RAY INTENSITY OF FEBRUARY 23, 1956.

M.Kodama, I.Kondo, K.Murakami, Y.Miyazaki, M.Wada, C.Ishii, T.Suda, T.Sekido and T.Yagi.
Rep. Ionosphere Res. Japan, Vol. 9, No. 1, 20-3 (March, 1957).

Reproduces records of cosmic-ray intensity from monitors located at: Mt. Norikura (geomag. lat. +25° 40'; 2840 m), Tokyo (Itabashi) (g. lat. +25° 30'; 20 m), Tokyo (Mabashi) (g. lat. +25° 27'; 44 m) and Nagoya (g. lat. +24° 44'; 50 m). The large increase in intensity around 0400 hr G.M.T. was registered by seven out of the ten monitors. Of the three which registered no significant increase two were shielded (by 90 cm Pb and 10 cm Pb respectively) and one was unshielded.
J.W.Gardner

537.59

15495 ON THE TRANSITION EFFECT OF THE NEUTRON GENERATING COMPONENT OF COSMIC RAYS IN LEAD.

I.Hauser.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 327-34 (1960). In German.

The neutron production in lead has been measured with boron-loaded Agfa K3 emulsions, up to 2.4 cm of generator thickness. The results show a flat behaviour of the integral curve of the generated neutrons, and this corresponds to an exponential decrease of the generating radiation. No maximum in the transition curve has been found.
G.Martelli

537.59

15496 THE TRANSITION EFFECT IN LEAD OF THE STAR-PRODUCING COMPONENT OF COSMIC RAYS.

I.Hauser, P.Landrock, K.Lanius, L.Mitrani and A.Peeva.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 335-8 (1960). In German.

Examines the transition region in a lead absorber of the component of cosmic radiation responsible for star production, at an altitude of 3000 m. No maximum of the star frequency was observed with a 1-2 cm thick absorber, in agreement with theoretical predictions.
S.J.St-Lorant

537.59 : 539.17

15497 AN EXPERIMENT ON NUCLEAR INTERACTIONS OF HIGH ENERGY (10-100 GeV).

E.R.T.Awunor-Renner, L.Blaskovitch, B.R.French, C.Ghesquiere, I.B.de Minvielle-Devaux, W.W.Neale, C.Pelletier, P.Rivet, A.B.Sahiar and I.O.Skillicorn.
Nuovo Cimento, Vol. 17, No. 2, 134-65 (July 16, 1960).

117 interactions of cosmic-ray particles with aluminium nuclei have been studied. 101 showers containing no apparent unstable particles yielded the following multiplicities: $\langle n_s \rangle = 7.3$; $\langle n_s^+ \rangle = 3.9$; $\langle n_s^- \rangle = 2.7$; $\langle n_s^\pm \rangle = 0.6$. The momentum and angular distributions of the secondary particles were examined, and an attempt was made to study the momentum-angle correlation. The mean transverse momentum was 0.31 GeV/c, the r.m.s. deviation about this mean being 0.23 GeV/c. A quantity related to the $(U-p_L)$ of the recoil nucleon was also investigated. 12 showers containing one V^0 each and 1 shower containing two V^0 particles were studied; this showed that the 117 showers contained: $29.5^{+14.0}_{-11.0}$ Λ^0 and $18.0^{+15.0}_{-10.0}$ θ^0 particles. 3 showers containing $V^\pm$ particles were also studied; one of them was probably a Ξ^- particle.

537.59 : 539.17

15498 A CLOUD CHAMBER STUDY OF NUCLEAR INTERACTIONS WITH ENERGIES OF ABOUT 100 GeV.

L.Montanet, J.A.Newth, G.Petrucci, R.A.Salmeron and Z.Zichichi.
Nuovo Cimento, Vol. 17, No. 2, 166-88 (July 16, 1960).

A cosmic-ray experiment to study 100 GeV nuclear interactions with a magnet cloud-chamber is reported. The analysis of the interactions is described and the hypotheses necessary for interpreting the measurements are discussed. Results from a first sample of 41 interactions are given. They show that (1) the transverse momenta of the secondary particles are generally low (<0.5 GeV/c) and (2) in the centre of momentum frame of reference the emitted particles mostly have low momenta and their angular distribution is anisotropic. There is also some evidence that in a nucleon–nuclear interaction at these energies the number of nucleons involved is small. The proportion of strange particles among the secondaries is similar to that found in interactions of much lower energy.

537.59 : 539.12

PRODUCTION OF PIONS BY COSMIC RAYS IN THE STRATOSPHERE. See Abstr. 15420

NUCLEUS

539.14

15499 AN APPLICATION OF THE STATISTICAL VARIATIONAL PRINCIPLE TO THE THEORY OF THE ATOMIC NUCLEUS. V.G.Solov'ev and T.Gȳn.
Acta. phys. Hungar., Vol. 11, No. 3, 277-83 (1960). In Russian.

Investigates the superfluid state of the finite nucleus at non-zero temperatures. The temperature of the phase transition of a nucleus from the superfluid to the normal state is obtained; the behaviour of thermodynamic quantities at temperatures close to zero, as well as close to the critical temperature, is considered.

539.14

15500 NUCLEON CLUSTERS IN THE NUCLEAR SURFACE. D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 4, 215-18 (Feb., 1959).

The absorption of slow K^--mesons by complex nuclei frequently results in the emission of fast $\Sigma^{\pm}$-hyperons unaccompanied by π-mesons. This observation is combined with the argument of Jones that such absorption is a surface phenomenon to suggest that the nuclear surface is rich in nucleon clusters, possibly "alpha-particles".

539.14

15501 NATURES OF NUCLEAR FORCE INDICATED BY THE PHOTODISINTEGRATION OF THE DEUTERON. III. S.H.Hsieh.
Progr. theor. Phys., Vol. 19, No. 4, 453-4 (April, 1958).

For Pt II, see Abstr. 6895 of 1957. It is shown that an accurate measurement (less than 10% error) of the total cross-section of the $d(\gamma, p)n$ reaction, at about $E_\gamma = 10$ MeV, is able to determine the sign of the δ_1^1 phase shift, and so test the applicability of the pion potential. A.M.Green

539.14

15502 A RELATIONSHIP BETWEEN THE PARAMETERS OF THE SINGLET EVEN POTENTIAL OF GAMMEL AND THALER. M.Fabre de la Ripelle.
C.R.Acad. Sci (Paris), Vol. 250, No. 24, 3958-9 (June 13, 1960). In French.

Derives an approximate relationship between the depth, range and core radius for hard-core Yukawa potentials which fit a given zero-energy scattering length. Verifies this relation for some examples given by Gammel and Thaler. R.J.N.Phillips

539.14

15503 AN INVESTIGATION INTO THE MOMENTUM DISTRIBUTION IN LIGHT NUCLEI. C.M.Pujara and K.M.Gatha.
Indian J. Phys., Vol. 33, No. 6, 243-62 (June, 1959).

The characteristic nuclear density distribution for light elements has been obtained by Gatha and Shah. Using this density distribution, the nucleonic momentum distributions have been obtained on the basis of the Thomas—Fermi—Weizsäcker method for carbon and oxygen. Using these momentum distributions the proton energy spectra, resulting from the inelastic scattering at 30° and 40° of 340 MeV protons by these elements, have been calculated. Using the momentum distribution for carbon, the production efficiences and the meson energy spectra at 45°, 90° and 135°, resulting from the photo-production of mesons on carbon, have also been calculated.

539.14

15504 FOUNDATION OF DEFORMED POTENTIAL MODEL FOR NUCLEAR ROTATION. K.Ikeda, M.Kobayasi, T.Marumori, S.Nagata and T.Shiozaki.
Progr. theor. Phys., Vol. 20, No. 6, 960-70 (Dec., 1958).

Following the method of Bohr and Mottelson, the separation of the nuclear Hamiltonian into rotational and intrinsic parts is considered. In the light of this formulation, various methods using the deformed potential model for the estimation of the moments of inertia for nuclear rotation are discussed and the interrelation among these methods is clarified. Treatments are restricted to the two-dimensional case for simplicity.

539.14 : 539.17

"MOLECULAR" STATES FORMED BY TWO CARBON NUCLEI. See Abstr. 13251-3

5:

15505 THE UNIFIED MODEL FOR Si^{29}. S.P.Pandya.
Progr. theor. Phys., Vol. 21, No. 3, 431-4 (March, 1959).

The weak-coupling unified model is applied to the low-lying levels of Si^{29}. It is shown that, although the energy levels are predicted quite successfully by the model, it has only qualitative success in explaining other properties such as the magnetic moment or β-decay of P^{29}.

53

15506 THE BINDING ENERGY OF Λ- PARTICLES IN NUCI MATTER. J.D.Walecka.
Nuovo Cimento, Vol. 16, No. 2, 342-9 (April 16, 1960).

From an analysis of the existing data on the binding energy Λ particles in hyperfragments a fairly reliable value of the bindi energy of Λ particles in nuclear matter can be obtained. This v is $V_0 \cong 22$ MeV. It is proposed that this number gives an indepe check on the validity of potentials deduced from the very light hy fragments. Some simple calculations using the techniques of Brueckner et al. are carried out with the potential of Lichtenber Kovacs (which contains a hard core). It is found that if only s wa interactions are considered one finds good agreement with the a number. If higher partial waves are included one obtains far too much binding energy and it is suggested that the Λ—nucleon inter may be weakened by an exchange force in these states.

53

15507 THE TOTAL DISINTEGRATION ENERGIES OF β-EMITTERS AND SHELL MODELS OF NUCLEI. M.E.Nahmias.
J. Phys. Radium, Vol. 19, No. 4, 485-9 (April, 1958). In French.

Plots of the total disintegration energy of β-emitters as a fu tion of the number of neutrons or protons show discontinuities fo magic and semi-magic numbers for both nucleons. However sor discontinuities in the two plots do not coincide, which is further evidence of the different behaviour of protons and neutrons in th process of filling the nuclear shells.

539

15508 NUCLEAR SHELLS AND DISINTEGRATION ENERGI OF β EMITTERS. M.E.Nahmias.
J. Phys. Radium, Vol. 20, No. 4, 482-7 (April, 1959). In French.

The plots of Q_β versus the number of protons or neutrons gi in the previous paper (see preceding Abstract) have been revise with the help of information from "Table of Isotopes" (see Abstr. 9027 of 1958). There are still discontinuities in the two kinds of plots which do not coincide.

539.14 : 53

THE NUCLEAR COMPRESSIBILITY FROM ISOTOPE SHIFT DATA. See Abstr. 13393

539

15509 NUCLEAR MOMENTS OF INERTIA. T.Miyazima and Y.Wada.
Progr. theor. Phys., Vol. 21, No. 2, 269-98 (Feb., 1959).

The problem of nuclear moments of inertia is considered tak into account the effect of the internal motion phenomenologically. The kinetic energy of the internal motion is assumed to take the form of that of a symmetrical top. When the interactions betweer the irrotational and the internal motions are strong the total syst has again a rotational energy spectrum whose moment of inertia given by the sum of those of two motions. By means of the empir data for the electric quadrupole excitations their magnitudes are estimated. In consequence the internal motion is shown to be ver important. Comparison with other methods is carefully examined especially with the work by Hayakawa and Marumori.

539

15510 MOMENTS OF INERTIA ACCORDING TO INGLIS ANI THE BOHR—VAN LEEUWEN THEOREM. G.Lüders.
Z. Naturforsch., Vol. 15a, No. 5-6, 371-7 (May - June, 1960). In German.

It was stated by Bohr and Mottelson (1953) that Inglis' metho (Abstr. 1110 of 1955; 623 of 1957) for the theoretical determinati of moments of inertia of deformed nuclei, in the limit of a great number of non-interacting particles leads to the moment of inerti of rigid rotation. Recently doubts have been raised regarding the eneral validity of this statement. In the present paper the proof of e assertion is given in detail and its relation to the Bohr—an Leeuwen theorem is discussed.

539.14

15511 NUCLEAR SPIN AND HYPERFINE INTERACTION OF In^{113m}. W.J.Childs and L.S.Goodman.

hys. Rev., Vol. 118, No. 6, 1578-81 (June 15, 1960).

The hyperfine structure of the 1.7 hr, 393 keV metastable state f In^{113} was studied by use of the atomic-beam magnetic resonance echnique. The nuclear spin is found to be $\frac{1}{2}$ and the magnetic ipole moment to be −0.210 50 ± 0.000 02 n.m., subject to a possible yperfine anomaly. The hyperfine separation in the atomic $P_{1\,2}$ state s measured to be 781.084 ± 0.010 Mc/s.

539.14

15512 GENERAL THEORY ON SPIN-ECHOES FOR ANY COMBINATION OF ANY NUMBER OF PULSES. NTRODUCTION OF A SIMPLE "SPIN-ECHO DIAGRAM". E.Jensen.

cta polytech. Scand. Ph 7. (283/1960), 20 pp.

The effects of diffusion damping of spin-echo amplitudes were rst treated by Hahn. An improvement of Hahn's averaging procedre was suggested by Das and Saha. Their theory, however, as is hown here, contains an error. This is corrected, and the revised heory is shown to give for a special case the same result as obained by different methods by Carr and Purcell and by Torrey. urthermore the revised theory is extended to account for any comination of pulses, and it is shown that the results are conveniently ummarized in a simple "spin-echo diagram".

539.14 : 539.12

EFFECT OF NUCLEAR MAGNETIC MOMENT ON THE BREMSSTRAHLUNG OF ELECTRONS. See Abstr. 15322

539.14 : 539.2 : 538.27

15513 ESTIMATE OF THE NUCLEAR MOMENT OF Ni^{61} FROM ELECTRON SPIN RESONANCE.

J.W.Orton, P.Auzins and J.E.Wertz.

Phys. Rev., Vol. 119, No. 5, 1691-2 (Sept. 1, 1960).

The electron spin resonance spectra of nickel and cobalt were studied in single crystals of MgO. Hyperfine structure was detected from the Ni^{61} isotope in the spectrum of Ni^{2+} and the hyperfine splitting constant A^{61} found to be (8.3 ± 0.4) × 10^{-4} cm^{-1}. X-irradiation of cobalt-containing crystals results in the formation of Co^{+} (isoelectronic with Ni^{2+}). The hyperfine splitting constant A^{59} is (54.0 ± 0.2) × 10^{-4} cm^{-1}. Comparison between A^{59} and A^{61} yields a value of 0.30 ± 0.02 n.m. for the nuclear moment of Ni^{61}.

539.14 : 539.18

SPECTROSCOPIC DETERMINATION OF THE NUCLEAR MOMENTS OF THE ODD GADOLINIUM ISOTOPES. See Abstr. 13420

539.14

15514 QUADRUPOLE MOMENT OF Fe^{57m}. R.Bersohn.

Phys. Rev. Letters, Vol. 4, No. 12, 609-10 (June 15, 1960).

Recent measurements (Abstr. 11561 of 1960) have shown that the quadrupole coupling constant e^2qQ of the 14.4 keV metastable state of Fe^{57} in α-Fe$_2$O$_3$ is (−23.0 ± 5.8) × 10^{-9} eV. (≡ −5.6 ± 1.4 Mc/s). Similarly, (Abstr. 548 of 1951) the absolute value of this constant in α-Al$_2$O$_3$ is ±2.393 Mc/s. These results, together with crystallographic data for the lattices of these two materials have yielded a rough value of −0.19 barn for the quadrupole moment of Fe^{57m}.

R.E.Meads

539.14 : 539.19

NUCLEAR QUADRUPOLE MOMENT OF NITROGEN. See Abstr. 13443

539.14

15515 THEORY OF RADIATIVE TRANSITIONS: GENERAL FORMULAE AND APPLICATIONS TO RESONANCE SCATTERING AND MULTIPLE SCATTERING (EXCITATION TRANSFERS). E.Arnous and Y.Héno.

J. Phys. Radium, Vol. 19, No. 4, 443-62 (April, 1958). In French.

An elementary method is used to establish unambiguously, the following general and convergent expressions: (1) the probability amplitudes for transitions involving one (or three) and two (or four) quanta, (2) the probability amplitude for the initial state up to the fourth order in:

$$e(4\pi\hbar c)^{-1/2} = (1/137)^{1/2}$$

(3) the scattering matrix up to the fourth order. These expressions are valid for large time values. The mass is renormalized. The displaced level representation is introduced and the virtual states are eliminated. The level displacement and breadth matrices are grouped with the corresponding energies in order to form damping terms. Degeneracy effects are taken into account. Two applications are treated in detail; resonance scattering and multiple scattering (excitation transfers).

539.14

15516 OCTUPOLE TYPE DEFORMATION OF NUCLEAR SURFACE. S.Suekane.

Progr. theor. Phys., Vol. 21, No. 1, 74-84 (Jan., 1959).

The shell structure dependence of the surface rigidity to nuclear octupole type deformation is examined. In order to calculate the energy change due to octupole type deformation, a coordinate transformation which transforms a deformed surface into a spherical one is introduced. The results of these calculations are in good agreement with the trend of experimental data suggested by low-lying odd-parity states of even—even nuclei and displays a characteristic shell structure dependence as well as quadrupole type deformation. According to the deformed potential model, it is shown that octupole-type deformations are closely connected with quadrupole-type deformations. This fact may play an important role in determining the spin values of low-lying odd-parity states of even—even nuclei and in understanding a mechanism of asymmetric fission.

539.14

15517 THE MÖSSBAUER EFFECT IN PYRITES AND MARCASITE. I.Solomon.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3828-30 (June 8, 1960). In French.

The observations in two different structures of FeS$_2$ allowed a determination of the quadrupolar interaction between the excited state of Fe^{57} ($I' = \frac{3}{2}$) and the crystalline field. The centre of the spectrum is displaced towards positive energies by an amount $\epsilon = +3.8 \pm 0.2$ Mc/s.

D.J.Oliver

539.14

15518 WIDTH AND INTENSITY OF THE MÖSSBAUER LINE IN IRON-57. M.Cordey-Hayes, N.A.Dyson and P.B.Moon.

Proc. Phys. Soc., Vol. 75, Pt 5, 810-12 (May 1, 1960).

Sources of Co^{57} have been prepared by beating and rolling a fragment of a cyclotron target containing 2.2% Fe^{57} to a thickness of 20 mg cm^{-2} and also by coprecipitation of Co^{57} and Fe^{57} hydroxides followed by reduction to the metal. These sources, together with a 24.7 mg cm^{-2} absorber were used to determine the width and intensity of the Mössbauer resonant absorption line for the 14.4 keV γ-radiation of Fe^{57}. The ratio of the counting rates with the source moving to those with source stationary was plotted for different source velocities and the results indicate that the sources were emitting lines of natural width. Using another, isotopically enriched, absorber, the experiments yielded a value for the fraction of radiation emitted in the narrow line and hence the Debye—Waller factor for the source. This was ~ 60% compared with an expected value of 72% assuming a Debye temperature of 355°K for iron. Also, a value of 1.4 × 10^{-19} cm^2 was obtained for the initial cross-section for resonance absorption. This result is fairly consistent with full splitting in the internal magnetic field, of the levels concerned in the transition.

R.E.Meads

539.14

15519 THE INFLUENCE OF A MAGNETIC FIELD ON THE RESONANCE ABSORPTION OF γ-RAYS.

V.A.Lyubimov and A.I.Alikhanov.

Zh. eksper. teor. Fiz., Vol. 38, No. 6, 1912-14 (June, 1960). In Russian.

The Mössbauer effect was used to study the Zeeman splitting of the 23.8 keV γ-transition in Sn^{119m}. The magnetic moment of the excited state, which was found to depend weakly on the value adopted for the Debye temperature for white tin, was calculated to be −(1.1 ± 0.1) times the ground state magnetic moment.

E.A.Sanderson

539.14 : 539.2

15520 ON THE THEORY OF THE RESONANCE INTERACTION OF γ-QUANTA IN CRYSTALS. M.V.Kazarnovskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1652-4 (May, 1960). In Russian.

The probability of elastic (Mössbauer) resonance interaction of γ-quanta with crystals contains the factor $f = \exp[g_\infty(T)]$. It is shown here that $g_\infty(T)$ can be calculated directly from experimental data of the thermal capacity at constant volume C_v.
E.A.Sanderson

539.14

15521 COLLECTIVE EXCITATIONS OF [AXIALLY-SYMMETRIC] EVEN—EVEN ATOMIC NUCLEI.
A.S.Davӯdov and G.F.Filippov.
Acta phys. Hungar., Vol. 9, No. 1-2, 169-76 (1958). In Russian.

In this calculation it is not assumed that a rotational energy is much smaller than a vibrational energy. For different deformation parameters, the energy ratios of the collective excitations and the succession of spins are computed. It is shown that the energy of the collective excitations can be represented as a function only of two parameters: $a_0 = (C/B)^{1\ 2}$ and $\delta = \beta_0(Be/\hbar^2)^{1/4}$. In the region $\delta > 2.5$, the excitation spectrum can be represented as a system of rotational vibrational bands. In the region $\delta < 2.5$, the excitation energy cannot be separated into rotational and vibrational components. In the region $\delta < 0.4$, the appearance of some special excitations is possible, in consequence of the negative quadrupole moments of the excited states. A comparison with experimental results is made.

539.14

15522 POSSIBILITY OF INVESTIGATING THE LEVELS OF THE COMPOUND NUCLEUS PRODUCED BY INTERACTIONS BETWEEN SLOW NEUTRONS AND ISOMERS.
Yu.V.Petrov.
Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1170-2 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 833-4 (April, 1960).

The possibility is discussed of using the bombardment of isomer nuclei by slow neutrons to obtain information about levels of the compound nucleus at high excitation energy. Comparison would be made with the bombardment of the unexcited nucleus giving lower excitation energies. An estimate is given showing that the required number of isomeric nuclei could be produced in a high flux reactor.
A.Ashmore

539.14 : 539.18

STABILITY AND ENERGY LEVELS OF VERY-HEAVY ISOTOPES OF HYDROGEN AND HELIUM. See Abstr. 15670

539.14 : 539.17

15523 ENERGY LEVELS OF ^{6}Li AND ^{6}He FROM A STUDY OF THE ^{7}Li(^{3}He,α)^{6}Li AND ^{7}Li(t,α)^{6}He REACTIONS.
K.W.Allen, E.Almqvist and C.B.Bigham.
Proc. Phys. Soc., Vol. 75, Pt 6, 913-28 (June, 1960).

An experimental technique is described for accelerating tritium and He^3 ions in a 1 MeV h.t. set and recovering the gas used by the ion source. Energy levels in He^6 at 1.71 and 3.4 MeV and in Li^6 at 2.19, 3.56, 4.3, 5.35, 5.6, 6.63, 7.4, 8.37 and 9.3 MeV were observed in a study of the reactions Li^7(t,α)He^6 and Li^7(He^3,α)Li^6 at bombarding energies in the range 600 to 900 keV. A classification of the levels was attempted assuming charge independence of nuclear forces and good agreement is obtained with the intermediate coupling model suggested by Inglis in 1953 (Abstr. 6169 of 1953) for a coupling parameter near the (LS) extreme.

539.14

15524 A FAST HYPERFRAGMENT PRODUCED BY A HEAVY PRIMARY COSMIC RAY.
U.Camerini, W.F.Fry, T.Groves and H.Huzita.
Nuovo Cimento, Vol. 15, No. 3, 498-9 (Feb. 1, 1960).

Describes an event produced by a heavy primary cosmic-ray which can be interpreted as the decay in flight of a $_\Lambda H^4$ hyperfragment into a proton and three neutrons.
S.J.St-Lorant

539.14

15525 EMISSION OF HYPERFRAGMENTS IN CAPTURE STARS OF NEGATIVE HYPERONS AT REST.
G.Dascola, C.Lamborizio, S.Mora and I.Ortalli.
Nuovo Cimento, Vol. 16, No. 2, 241-6 (April 16, 1960).

Five hyperfragments, emitted from a total of 137 Σ^- stars at rest, have been observed. The estimate of the emission probability of such events is (1.2 ± 0.5)% and is lower than the similar esti of (3.4 ± 0.6)% for the hyperfragments from the K$^-$ stars at rest served in the same stack.

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15526 SATURATION IN A HYPERON SYSTEM. V.A.Filimonov.
Zh. eksper. teor. Fiz., Vol. 36, No. 6, 1941-2 (June, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 6, 1380-1 (Dec., 1959).

The possibility that large systems of Λ-hyperons and nucle may be stable is discussed. An estimate of the binding energy i made under certain assumptions about the hyperon—nucleon forc which confirms this possibility.
J.Golds

539.14 : 539.1

NUCLEI CONSISTING SOLELY OF NEUTRONS. See Abstr. 1

539.14 : 53

NUCLEAR STRUCTURE AND SIMPLE NUCLEAR REACTIO See Abstr. 13227

RADIOACTIVITY . NUCLEAR DECAY

53

15527 ISOTOPE LABELLING BY MEANS OF ELECTRICAL GASEOUS DISCHARGES.
T.Westermark, H.Lindroth and B.Enander.
Internat. J. appl. Radiation and Isotopes, Vol. 7, No. 4, 331-4 (Feb., 1960).

Because ionizing radiation is known to act as a catalyst (the mechanism is, at present, not known) the authors have investigate the possibility of using radio and microwave discharges to produc the same effects. The potential advantage of these agents is a re tion in the reaction times. Some preliminary results are given of the tritium labelling of para-amino-salicyclic acid using microwaves. It is pointed out that the method could have a wide applicability, i.e. it could be used for all radioactive or stable isotopes which can be put into the gaseous form at workable temperatures.
C.F.Barn

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15528 A METHOD OF CONTINUOUS DOSIMETRY OF RADO IN THE AIR. D.Blanc, J.Fontan and G.Verdenne.
C.R.Acad. Sci. (Paris), Vol. 250, No. 22, 3629-31 (May 30, 1960). In French.

Describes a continuous flow method of estimating the radon concentration in air by aspirating the air through a series of filter into a large chamber, and measuring the α-activity of the radon decay products trapped by a second set of filters. The sensitivity of the instrument is 2×10^{-14} curies/litre.
S.J.St-Lora

539.

15529 A CARBON-14 BETA-RAY STANDARD, BENZOIC ACID-7-C^{14} IN TOLUENE, FOR LIQUID SCINTILLATI COUNTERS. W.F.Marlow and R.W.Medlock.
J. Res. Nat. Bur. Stand., Vol. 64 A, No. 2, 143-6 (March-April, 19

A C^{14} beta-ray standard for use in liquid scintillation counting has been prepared and standardized. The sample consists of benz acid-7—C^{14} dissolved in toluene. Samples of the solution were oxidized quantitatively in a Paar oxygen bomb, and the radioactivit of the carbon dioxide was compared with the radioactivity of carbo dioxide prepared quantitatively from the Bureau's sodium carbonate—C^{14} standard.

539.16 : 539.1.

15530 ON THE USE OF G.M.COUNTERS FILLED WITH A MIXTURE OF CO_2 + CS_2 FOR THE MEASUREMENT O THE ACTIVITY OF NATURAL CARBON. I. DISCUSSION OF THE TECHNIQUES EMPLOYED IN THE MEASUREMENT OF THE ACTIVITY OF NATURAL CARBON. W.Mościcki.
Acta phys. Polon., Vol. 17, No. 5, 311-26 (1958).

Comparisons are made of the techniques of measuring the rad activity of natural carbon using (a) solid carbon and screen wall counters (b) gas samples. The gas sample technique is advantage from the point of view of sensitivity, use of material, change of samples, and less contamination. One difficulty with this techniqu proportional counters are employed, is the complicated elec- ic apparatus and the lack of control of the background level ng the measurement. Statistical methods are discussed of con- ing the background by employing the fluctuation of the intensity e cosmic radiation in the counter and the shielding.

539.16 : 539.1.07

.5531 ON THE USE OF G.M.COUNTERS FILLED WITH A MIXTURE OF $CO_2 + CS_2$ FOR THE MEASUREMENT OF ACTIVITY OF NATURAL CARBON. II. EXPERIMENTS WITH COUNTERS FILLED WITH CO + CS USED FOR DETECTION ^{14}C IN NATURAL CARBON.

W.Mościcki.

phys. Polon., Vol. 17, No. 5, 327-43 (1958).

A number of experiments were conducted with G.M. counters d with $CO_2 + CS_2$. The counter has a long plateau with a small e and low sensitivity to contamination. The change in the num- of the counter-shielding anticoincidences as a function of the y time of the shielding signals is interpreted as resulting from e delay in counters of this type. According to this interpretation ut 65% of the pulses are subject to a mean delay of about 0.8 msec. influence of the delay effect on the efficiency and suitability of counter for chronometric purposes are also discussed. Repro- ble results are obtained with a sufficiently long time delay of a.c. shielding pulses (~5 msec) over a broad interval of CO_2 ssure and counting efficiency of about 90% for counters with a me of 2-3 litres.

539.16 : 532.7

THE INFLUENCE OF RADIOACTIVE RADIATION ON THE LUTION PROCESS OF A SOLID. See Abstr. 14646

539.16

15532 THE NEW ISOTOPE Te^{115}.

I.P.Selinov, N.A.Vartanov, D.E.Khulelidze, Yu.A.Bliodze, .Zaitseva and V.A.Khalkin.

eksper. teor. Fiz., Vol. 38, No. 5, 1654 (May, 1960). In Russian.

The half-life for the disintegration of Te^{115} was found to be ± 0.5 min from an experimental study. E.A.Sanderson

539.16

15533 CHARACTERIZATION OF THE 10 HOUR ^{196}Au ISOMER.

R.Van Lieshout, R.K.Girgis, R.A.Ricci, A.H.Wapstra d C.Ythier.

ysica, Vol. 25, No. 8, 703-7 (Aug., 1959).

The Au^{196} isomer was found to decay with a half-life of 10.0 ± hours. Scintillation spectrometer and beta-ray spectrometer udies have shown the existence of four transitions. The half-life governed by an M4 isomeric transition of 176 ± 2 keV which is lowed by two gamma rays of 149 ± 2 and 186 ± 2 keV in cascade; ransition of 84 ± 2 keV is probably in cascade with other transi- ns.

539.16

15534 NEW ISOMER Sn^{113m}.

I.P.Selinov and V.L.Chikhladze.

. eksper. teor. Fiz., Vol. 38, No. 3, 1012 (March, 1960). In ssian.

The metastable isomer Sn^{113m} decays with a half-life of ± 3 min. Conversion measurements and parity considerations tablish that the associated gamma-ray must be of M4 polarity. J.W.Gardner

539.16

15535 THE LIFETIME OF THE 3.85 MeV LEVEL IN ^{13}C.

O.Dietzsch, M.Kuchnir, W.R.Phillips and O.Sala.

. Acad. Brasil Cienc., Vol. 31, No. 4, 523-8 (1959).

From observation of the absence of Doppler shift of the 170 keV ray emitted following the reaction $B^{10}(\alpha,p)C^{13*}$, it is inferred that e lifetime of the 3.85 MeV level is greater than 1.5×10^{-12} sec. is, together with a measurement of the branching ratio of the state r the E1 emission to the 3.68 MeV level and for the M2 emission the ground state, enables one to place the limits $(M)^2 < 0.1$ and $)^2 < 5.0$ for the E1 and M2 (assumed pure) transitions, respectively.

539.16

15536 THE LEVEL SCHEME OF ^{112}Cd.

R.K.Girgis and R.van Lieshout.

hysica, Vol. 26, No. 11, 1200-10 (Nov., 1959).

The level scheme of Cd^{112} has been investigated by studying the amma ray spectrum from the decay of Ag^{112} which excites levels in is nuclide. A source of $Pd^{112}-Ag^{112}$ in equilibrium was used. Gamma rays of 615, 690, 785, 855, 980, 1090, 1210, 1310, 1400, 1490, 1620, 1810, 1930, 2110, 2240, 2300, 2520, 2540, 2680, 2710, 2830, 2950, 3100 and 3280 keV were found to follow the decay of Ag^{112}. The summing spectrum was examined using a well type NaI(Tl) crystal with the source in different geometries; summing peaks of 3560, 3300, 3130, 2830, 2710, 2450, 2230 and 2050 keV were observed. Gamma–gamma coincidences were performed using a conventional fast–slow coincidence circuit. The results of these coincidence measurements are listed. A level scheme for Cd^{112}, based on the intensity values of the various gamma rays following the decay of Ag^{112} and on the summing and gamma–gamma coincidence measurements is presented.

539.16

15537 THE LIFETIME OF THE 321 keV LEVEL IN Hf^{177}.

G.A.Vartapetyan.

Zh. eksper. teor. Fiz., Vol. 38, No. 6, 1916-17 (June, 1960). In Russian.

Using the method of delayed coincidences, the average lifetime of the 321 keV level was found to be $(7 \pm 2) \times 10^{-10}$ sec, and the half-life $(5 \pm 1.5) \times 10^{-10}$ sec, which is in good agreement with the value of $\sim 4 \times 10^{-10}$ sec obtained from intensity and angular correlation measurements. Absolute values for the probabilities of the 321 keV and the 208 keV E1 transitions are calculated to be 5.5×10^7 sec^{-1} and 1.4×10^9 sec^{-1} respectively. The transitions are briefly compared with similar transitions in neighbouring nuclei. E.A.Sanderson

539.16

15538 NUCLEAR SPECTROSCOPY OF NEUTRON-DEFICIENT Lu, Ta, AND Re ISOTOPES.

B.Harmatz, T.H.Handley and J.W.Mihelich.

Phys. Rev., Vol. 119, No. 4, 1345-67 (Aug. 15, 1960).

The systematic behaviour of nuclear energy levels was studied with Lu (Z = 71), Ta (Z = 73), and Re (Z = 75) activities produced in a proton cyclotron. Conversion-electron data are presented for electron-capture decay of $Lu^{170,174m}$, Ta^{173-8}, and $Re^{179,181}$. Level schemes are proposed based on these and on previously published transition data for $Lu^{169,171}$. The properties of odd-A nuclei in the strongly deformed region of odd-N numbers 95-107 are discussed in connection with predictions of Mottelson and Nilsson (Abstr. 3822 of 1959). Two activities, Lu^{174m} and Re^{179} (~20 min), are previously unreported.

539.16

15539 A DELAYED COINCIDENCE MEASUREMENT OF THE 2.9×10^{10} SEC-HALF-LIFE OF THE 279 keV FIRST EXCITED STATE IN THALLIUM 203.

E.Bashandy, T.R.Gerholm and J.Lindskog.

Ark. Fys., Vol. 17, Paper 24, 421-6 (1960).

The half-life of the 279 keV first excited level in Tl^{203} has been measured by the delayed coincidence technique. An electron–electron coincidence spectrometer was used for the energy resolution. A half-life of $(2.9 \pm 0.2) \times 10^{-10}$ sec has been obtained, in good agreement with earlier results from delayed coincidences, nuclear resonance and Coulomb excitation measurements. The reduced transition probability for the E2 transition and the matrix element for the M1 transition were calculated and compared with those obtained from the single particle model.

539.16

15540 MEAN LIFE OF THE 279 keV LEVEL OF Tl^{203}.

S.Gorodetsky, R.Manquenouille, R.Richert and A.Knipper.

C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 65-7 (July 4, 1960). In French.

Using a Hg^{203} source, the mean life of the 279 keV level of Tl^{203} was determined. The 279 keV γ-rays and 207 keV β-particles were observed using a plastic scintillator. A good resolution time was obtained using a time–amplitude converter, the full width being 9.2×10^{-10} sec. The mean life was $T_{1/2} = 2.83 \pm 0.17 \times 10^{-10}$ sec, in excellent agreement with previously published measurements. Using known values of the conversion coefficient and mixing ratio the M1 and E2 transition probabilities were compared with those calculated using the independent-particle model. The M1 transition probabilitiy was found to be reduced by a factor of 1000, whilst the E2 probability was increased by a factor of 10. R.H.Thomas

539.16 : 539.

O^{14} DECAY: ELECTROMAGNETIC CORRECTIONS. See Abstr. 15379

539.16

15541 ALPHA DECAY OF Np^{235}.

J.E.Gindler and D.W.Engelkemeir.

Phys. Rev., Vol. 119, No. 5, 1645-9 (Sept. 1, 1960).

The decay was found to be complex. Four groups were identified with energies of 4.864, 4.925, 5.015, and 5.095 MeV. The relative abundances of the respective groups are 0.8, 11.8, 83.6, and 3.8%. Hindrance factors calculated on the basis of a 7 × 10^4 year alpha half-life for Np^{235} are, 35, 6.1, 3.3, and 250, respectively. The electron capture decay energy of Np^{235} was determined to be 163 ± 15 keV based on a closed cycle calculation and the assumption that the 5.095 MeV alpha transition is to the ground state of Pa^{231}.

539.16

15542 A CORRECTION TO V.M. STRUTINSKII'S PAPER "EXCITATION OF ROTATIONAL STATES IN ALPHA-DECAY OF EVEN—EVEN NUCLEI.

V.M.Strutinskii.

Zh. eksper. teor. Fiz., Vol. 36, No. 6, 1957 (June, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol.36(9), No. 6, 1392-3 (Dec., 1959).

Deformation parameters of even—even nuclei are re-calculated using improved experimental results. Inexact results had been used in the previous paper (Abstr. 2535 of 1958). J.D.Dowell

539.16

15543 CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG FROM BETA EMITTERS.

A.Bisi, A.Fasana and L.Zappa.

Nuovo Cimento, Vol. 16, No. 2, 350-61 (April 16, 1960).

The results are reported of an investigation of the circular polarization—energy relation of the external bremsstrahlung radiation produced by β-rays from various β-emitters. It was found that at the upper limit of the spectra the circular polarization of the external bremsstrahlung quanta corresponds to a longitudinal polarization of β^--rays equal to: $-(1.05 \pm 0.04)$ v/c (P^{32}); $-(0.98 \pm 0.03)$ v/c (Y^{90}); $-(0.98 \pm 0.02)$ v/c (Tm^{170}). At the lower energy side of the spectra the circular polarization was found very high and larger than that estimated on the basis of present knowledge. Account is given of the attempts made to ascertain how the events which occur before an external bremsstrahlung quantum is radiated contribute to the measured polarization—energy relation.

539.16

15544 THE FIRST FORBIDDEN β-DECAY.

T.Kotani and M.Ross.

Progr. theor. Phys., Vol. 20, No. 5, 643-89 (Nov., 1958).

The energy spectrum, longitudinal polarization, and various β—γ correlations, with and without measurement of β or γ-ray polarizations, are calculated for the first-forbidden β-decay. The theoretical expressions include finite nuclear size effects, in the form of a simple modification of older expressions. A short discussion of relevant Coulomb functions is presented. Interference from so-called third-forbidden transitions is also included. The expressions are presented in a reasonably accurate expansion such that the energy dependence, dependence on real and imaginary parts of coupling constants, and dependence on independent nuclear matrix elements, are clearly revealed. Possibilities for testing the time reversal invariance of the interaction are discussed. The β—γ directional correlation is probably most useful for this purpose among the various possibilities in the first-forbidden transition. The transverse β-polarization is probably not useful for this purpose (it may, however, be used to determine nuclear matrix elements). Determination of other general properties of the β-decay interaction from first-forbidden decays is probably even more difficult. Special information that might, however, be obtained from examination of a 0—0 transition is discussed. It is proposed that there is a fruitful field for determining properties of specific nuclei by measurement of several properties of a single decay. Both accurate and simplified expressions are presented to show what may be looked for. Absolute measurement of γ-polarization following β-decay and measurement of the β—γ correlation and its energy dependence are very promising experiments; as are of course, the widely known accurate spectrum and longitudinal polarization measurements. A special discussion is presented of RaE(Bi^{210}), where it is pointed out that accurate longitudinal polarization measurements could be very helpful.

5

15545 ON THE DECAY OF ^{74}Ga.

C.Ythier, W.Schoo, B.L.Schram, H.L.Polak, R.K.Gi R.A.Ricci and R.Van Lieshout.

Physica, Vol. 25, No. 8, 694-702 (Aug., 1959).

The beta and gamma radiations from the decay of 8 minute Ga^{74}, produced by fast neutron bombardment of natural germani and by deutron bombardment of enriched Ge^{76}, were studied by of scintillation techniques. In addition to very strong gamma ra 0.600 and 2.35 MeV and five relatively strong gamma rays of 0. 1.02, 1.20, 1.45 and 1.96 MeV, eleven weaker transitions were served. Two beta-ray branches could be resolved with maximu energies of 2.7 and 4.3 MeV. Some speculations are made abou possible level scheme for Ge^{74}.

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15546 SHAPE OF BETA SPECTRA OF ONCE FORBIDDEN TRANSITIONS IN THE DECAYS OF Ga^{72}, La^{140}, Eu^{15} Eu^{154}, AND Sb^{124}.

L.M.Langer and D.R.Smith.

Phys. Rev., Vol. 119, No. 4, 1308-14 (Aug. 15, 1960).

Magnetic spectrometer studies are reported. The highest energy beta group of each of these transitions has an abnormall long comparative half-life and probably is a once forbidden deca from a 3− initial state to a 2+ final state. For all, the highest e beta spectrum was found to have a nonstatistical, nonunique shap On the assumption that the B_{ij} matrix element dominates the dec the experimental shape factors were fitted empirically by $C = q^2 + \lambda p^2 + D$. The best fits were obtained for values of D equ to 15, 10, 5, 20, and 15 for Ga^{72}, La^{140}, Eu^{152}, Eu^{154}, and Sb^{124}, respectively.

53

15547 A REINVESTIGATION OF THE DECAY OF Na-22.

M.K.Ramaswamy.

Indian J. Phys., Vol. 33, No. 3, 285-94 (July, 1959).

The amount of positron emission in the decay of Na^{22} has be determined to be 0.899 ± 0.003 using a 4π plastic beta scintillati spectrometer in conjunction with double and triple coincidence techniques. This leads to an ϵ/β + ratio of 0.112 ± 0.004 which i slightly better than the best earlier result of Sherr and Miller (Abstr. 4884 of 1954). Comparison of the measured value with th theoretical ratio of 0.1135 ± 0.002 leads to a value for the Fierz interference term $b_{GT} = -0.004 \pm 0.012$, showing the extreme smallness of the cross term in allowed Gamow—Teller transitior A brief summary is presented of the status of the Fierz term as revealed by the present studies and other work.

539

15548 BETA—GAMMA ANGULAR CORRELATION AT THE RESONANCE ENERGY.

M.Spighel.

J. Phys. Radium, Vol. 20, No. 4, 488-91 (April, 1959). In French.

The author studies the conditions for the success of an exper ment of beta—gamma angular correlation, with resonance fluores cence of the gamma-ray. Additions are made to previous calcula tions of other authors. Emphasis is placed on the calculation of quantities directly accessible to experiment.

539

15549 V AND A INTERACTIONS BY AT-RESONANCE β—γ ANGULAR CORRELATION IN ARSENIC 76.

M.Spighel.

C.R.Acad. Sci.(Paris), Vol. 250, No. 22, 3636-8 (May 30, 1960). In French.

The angular correlation between the $2^+ \rightarrow 2^-$ β-transition of 2.41 MeV from As^{76} and its cascade γ-ray of 560 keV, detected aft fluorescent resonance scattering from Se^{76} has been measured. I is shown to exclude S and T interactions and to be compatible only with V and A interactions, by considering the relative probabilitie of different angular momenta being removed by leptons, given by other methods. A.E.I.Research Laborato

539.

15550 β—γ ANGULAR CORRELATION IN ^{59}Fe AND PARITY CONSERVATION IN STRONG INTERACTIONS.

E.Fuschini, G.Giacomelli, C.Maroni and P.Veronesi.

Nuovo Cimento, Vol. 16, No. 5, 886-94 (June 1, 1960).

Nuclear β-decay leaves the residual nucleus partially polariz in the direction of emission of the β-particle. If parity conservati in nuclear states is violated, an asymmetry about 90° of a β—γ dir tional correlation can be present (existence of a $\bar{\sigma}_{\text{nucleus}} \cdot \bar{p}_\gamma \propto$ cos n). The asymmetry has been looked for in a $\beta-\gamma$ cascade of Fe^{59} a was found to be zero within one standard deviation of 0.3%. The ring of this result on an upper limit for F is discussed (F is the ative amplitude of the irregular wave-function with respect to regular one). As a by-product a value of (63.1 ± 0.8) days for the -time of Fe^{59} was obtained.

539.16

15551 INTERNAL CONVERSION ELECTRONS FOLLOWING COULOMB EXCITATION OF HIGHLY DEFORMED D-A NUCLEI.

E.M.Bernstein and R Graftzer.

ys. Rev., Vol. 119, No. 4, 1321-30 (Aug. 15, 1960).

The internal conversion electrons emitted following Coulomb citation of Eu^{153}, Dy^{161}, Dy^{163}, Ho^{165}, Tm^{169}, Lu^{175}, and Ta^{181} were asured. The relative intensities of the decay transitions from first two rotational states of these isotopes were compared with predictions of the rotational model of Bohr and Mottelson. In eral, there is good agreement between the experiment and theory; vever, the results for the Dy isotopes indicate some disagreement ich is outside the experimental uncertainty. For Eu^{153}, Dy^{163}, and ^{175}, transitions involving intrinsic states were observed in addition the rotational transitions. The reduced E2 transition probabilities these intrinsic transitions are appreciably larger than single-rticle estimates. The first rotational state in Lu^{176} was observed th a natural Lu target. The data indicate that this transition is edominantly M1.

539.16

15552 INTERNAL CONVERSION COEFFICIENT OF THE 92 KeV RADIATION FROM Pa^{234}.

R.Foucher.

Phys. Radium, Vol. 20, No. 4, 508-9 (April, 1959). In French.

Analysis of γ-ray and internal conversion X-ray spectra from e forbidden 92 keV M1 transition in the distorted odd—odd nucleus ^{234} gives an L-conversion coefficient between the limits 2.3 and 9, considerably below theoretical estimates (Rose 4.7, Sliv 4.2) is indicates the importance of the effect of nuclear structure on e conversion coefficient. A.E.I.Research Laboratory

539.16

15553 THE CONVERSION ELECTRON SPECTRUM EMITTED DURING THE $Pa^{233} \rightarrow U^{233}$ TRANSITION.

Albouy and M.Valadarès.

Phys. Radium, Vol. 20, No. 10, 816-26 (Oct., 1959). In French.

Magnetic spectrograph study, New lines have been observed, ergy values of various γ rays more precisely determined and eir multipolarity deduced. Relative intensities of some of these ys do not agree with the level scheme at present accepted.

539.16

15554 INTERNAL CONVERSION COEFFICIENTS OF E2 TRANSITIONS.

B.N.Subba Rao.

uovo Cimento, Vol. 17, No. 2, 189-97 (July 16, 1960).

A survey and analysis of all available data on internal con-ersion coefficients of pure E2 (2+ → 0+) transitions is presented. he results indicate the possibility of the internal conversion coef-cients depending on the deformation of the nucleus.

539.16

15555 OBSERVATIONS CONCERNING THE TYPE E2 γ-RADIATION OF DEFORMED ATOMIC NUCLEI ILSSON MODEL).

D.Bogdan.

uovo Cimento, Vol. 15, No. 5, 709-18 (March 1, 1960). In French.

The probabilities of γ-transitions of the E2 type were calculated sing the Nilsson representation which takes into account the coupling etween states of different N. For this purpose the results obtained calculation of electric quadrupole moments were used. The pplicate study of certain E2-type γ-transitions of some odd nuclei the region $150 < A < 188$ showed that it is necessary to make use the representation mentioned above. E.A.Sanderson

539.16

15556 ^{60}Ni (γ—γ) ANGULAR CORRELATION.

J.B.Garg and N.H.Gale.

uovo Cimento, Vol. 16, No. 6, 1014-19 (June 16, 1960).

This has been remeasured using time-of-flight techniques. The esults obtained are in close agreement with the theoretical correla-ion function for the γ—γ cascade transition: 4(E2)2(E2)0. The erits of the technique employed are discussed.

539.16

15557 GAMMA-RAY TRANSITIONS IN ^{155}Gd.

B.N.Subba Rao.

Nuovo Cimento, Vol. 16, No. 2, 283-91 (April 16, 1960).

Conversion coefficients of the 86 keV and 105 keV transitions following the β decay of Eu^{155} are determined to be $\alpha^{k}_{86} = 0.49 \pm 0.075$ and $\alpha^{k}_{105} = 0.29 \pm 0.054$ from studies with the intermediate image β-ray spectrometer and a scintillation spectrometer. In combination with L-subshell ratios, the mixing ratio, $\delta^2 = M2/E1$, is found to be $\delta^2_{86} < 0.04$ and $\delta^2_{105} < 0.07$. These multipolarities are discussed on the basis of the spheroidal shell model.

539.16

15558 DOSE DISTRIBUTION OF GAMMA RADIATION IN CYLINDRICAL VOLUMES OF WATER.

A.H.W.Aten,Jr and A.C.Pieterse.

Internat. J. appl. Radiation and Isotopes, Vol. 7, No. 4, 330 (Feb., 1960).

Preliminary measurements are reported on the variation in dose rate through the volume of 3 or 4 cylinders of water surrounding linear gamma-sources of Co^{60} and Cs^{137}. It is found that the dose rate varies considerably through the volume. This is important in industrial applications of γ-rays. S.E.Hunt

539.16

15559 ON THE DECAY OF ^{74}As.

R.K.Girgis and R.Van Lieshout.

Physica, Vol. 25, No. 8, 688-93 (Aug., 1959).

The gamma-ray spectrum of As^{74} was studied with a scintillation spectrometer. In addition to the gamma rays of 600 and 635 keV, others of 0.88, 1.00, 1.20 and very weaks ones of 1.61; 1.84 and 2.20 MeV were found. A level scheme is proposed for Ge^{74} with levels at 0.600 (2^+), 1.20 (2^+) and 2.20 MeV, and a probable one at 1.48 MeV.

539.16

15560 A NOTE ON THE DECAY OF Cs^{132}.

G.N.Whyte, B.Sharma and H.W.Taylor.

Canad. J. Phys., Vol. 38, No. 6, 877-80 (June, 1960).

The half-life of Cs^{132}, produced by the reaction $Cs^{133}(\gamma, n)\,Cs^{132}$ was found to be 6.48 ± 0.03 days, and the energy of the γ-ray emitted when Cs^{132} decays to Xe^{132} was 0.6679 ± 0.0004 MeV, on the assumption that the energy of the Cs^{137} γ-ray was 0.66162 ± 0.00010 MeV, the latter being counted alternately with the Cs^{132}. The resolution of the NaI(Tl) scintillation spectrometer was 8.6% at 0.662 MeV. The effect on the measurements of possible production of Cs^{132} in CsI(Tl) crystals under high energy γ-irradiation is briefly discussed. I.C.Demetsopoullos

539.16

15561 ANGULAR DISTRIBUTION AND LINEAR POLARIZATION OF GAMMA RAYS FROM ALIGNED ^{166m}Ho NUCLEI.

H.Postma, A.R.Miedema and M.C.Eversdijk Smulders.

Physica, Vol. 25, No. 8, 671-87 (Aug., 1959).

Measurements of the anisotropies and the linear polarization of γ-radiations from Ho^{166m} oriented in Nd-ethyl-sulphate are reported and discussed. The measurements give information about the multipole order of the γ-rays, the mixing ratio of two multipoles and the electric or magnetic character of the radiations. The 817 and 706 keV γ-rays are found to be nearly pure E2 and E1 radiations and the spins and parities of their initial levels (973 and 1790 keV) are 5- and 6-. The 1256 keV level has probably spin and parity 5-. The h.f.s. constant A/k and the magnetic moment μ of Ho^{166m} are 0.27 ± 0.03° K and 3.2 ± 0.5 n.m. if the spin I_0 of Ho^{166m} is 6. With $I_0 = 7$ or $I_0 = 8$ the values are 0.24 ± 0.02° K and 3.3 ± 0.5 n.m. or 0.22 ± 0.02° K and 3.5 ± 0.5 n.m. respectively. Some considerations from the point of view of the unified model are given.

539.16

15562 ON THE GAMMA RAYS EMITTED IN THE DECAY OF $^{140}_{59}Pr$.

S.Jha, R.K.Gupta and H.G.Devare.

Nuovo Cimento, Vol. 16, No. 5, 829-33 (June 1, 1960).

The γ-rays from Nd^{140}-Pr^{140} mixture were studied in a scintillation spectrometer. New γ-rays of energies (900 ± 20), (1600 ± 30) and (2500 ± 50) keV were detected and their intensities in comparison to the 511 keV annihilation radiation are (0.15 ± 0.05)%, (0.50 ± 0.10)% and (0.02 ± 0.01)% respectively. The branching ratio from the decay of Pr^{140} to the ground state, 1600 keV state and 2500 keV state of Ce^{140} have been estimated, from the photon intensities, to be 99%, ~1% and ~0.2% respectively giving the value of log ft ~ 5 for all these branches. An assignment of 1+ for Pr^{140} is suggested.

539.16

15563 DECAYS OF Rh^{106} AND Ag^{106}.
R.L.Robinson, F.K.McGowan and W.G.Smith.
Phys. Rev., Vol. 119, No. 5, 1692-1701 (Sept. 1, 1960).

The γ-ray spectra of 30 sec Rh^{106} and 8.3 day Ag^{106}, which both decay to Pd^{106}, were studied with scintillation spectrometers. Three $\gamma-\gamma$ angular correlations were also measured. The results are consistent with the following level scheme for Pd^{106}: 0.513(2+), 1.131(2+), 1.137(0+), 1.360 or 1.213, 1.563(2+), 1.73(2 or 3), 1.84, 1.88, 1.94(3- or 4+), 2.01, 2.052(4+), 2.09(3), 2.28, 2.305 (3 or 4), 2.352(4+), 2.46, 2.62, 2.764(5-), 2.87, and 3.08 MeV. The transition between the first and second 2+ levels was found to consist primarily of E2 radiation. The branching ratio obtained for the cascade to crossover γ-rays from the second 2+ level is 2.1 ± 0.3. This ratio combined with Coulomb excitation data of Stelson and McGowan gives a value of 1.0 ± 0.3 for the ratio $B(E2, 2' \rightarrow 2)/B(E2, 2 \rightarrow 0)$.

539.16

15564 STUDY OF THE GAMMA-RAY AND INNER BREMSSTRAHLUNG TRANSITIONS IN THE DECAY OF TIN-113. W.E.Phillips and J.L.Hopkins
Phys. Rev., Vol. 119, No. 4, 1315-21 (Aug. 15, 1960).

A fast—slow coincidence spectrometer was used. A 650-keV gamma ray found in the single-channel spectrum was shown to be in coincidence with the In K X-ray both in the fast and in the slow coincidence spectra. This confirmed the existence of a 650-keV level in In^{113} fed by a weak orbital capture branching. From the relative intensities of the 257 and 650 keV gamma rays (16.4 ± 1.9:1), it was determined that the spin of the 650 keV level is $\frac{5}{2}$ and the parity is odd. The absence of positrons and arguments from log (ft) classifications indicate a spin of $\frac{3}{2}$ and even parity for the ground level of Sn^{113} and a decay energy in the range of 0.8 to 1.6 MeV. The shape of the corrected inner bremsstrahlung spectrum indicated a decay energy of 1.3 ± 0.3 MeV

NUCLEAR REACTIONS

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NUCLEAR REACTIONS IN STARS. See Abstr. 14465

539.17 : 537.59

AN EXPERIMENT ON NUCLEAR INTERACTIONS OF HIGH ENERGY (10-100 GeV). See Abstr. 15497

539.17 : 537.59

CLOUD CHAMBER STUDY OF NUCLEAR INTERACTIONS WITH ENERGIES OF ABOUT 100 GeV. See Abstr. 15498

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15565 STATISTICAL MODELS FOR HIGH-ENERGY NUCLEAR REACTIONS. II. M.Neuman.
An. Acad. Brasil Cienc., Vol. 31, No. 4, 487-506 (1959).

Continues previous discussion (Abstr. 7541 of 1960). Mainly a treatment of calculational techniques, with emphasis on the thermodynamic limit. R.J.N.Phillips

539.17

15566 NOTE ON THE TARGET EXCHANGE CORRECTIONS IN WATSON'S THEORY OF THE OPTICAL MODEL POTENTIAL. J.Sawicki.
Nuovo Cimento, Vol. 15, No. 4, 606-13 (Feb. 16, 1960).

The generalization of Watson's theory of the optical model potential (Abstr. 2714 of 1953) to the case of completely antisymmetrized wave-functions of the A + 1 particles system given by Rollnik is discussed. The lowest order corrections to the nuclear potential in the Takeda and Watson formulation being of the target exchange type are estimated for several energies of the scattering nucleon.

539.17

15567 SHELL-MODEL REDUCED WIDTHS FOR EMISSION OF TRITONS AND He^3. A.Sǎndulesku.
Rev. de Physique (Bucarest), Vol. 5, No. 1, 103-18 (1960).
In Russian.

The reduced widths are calculated both in J—J and L—S coupling for the cases (a) n>3 nucleons, (b) one or two nucleons, outside a closed shell. The spin and isotopic-spin integrals are found exactly, while radial integrals entering the expressions are found under sumptions concerning the interior wave-function (e.g. Gaussian emitted particle. D.W.L.S

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15568 PROTON—NUCLEUS SCATTERING AT 96 MeV. A.Ghose.
Indian J. Phys., Vol. 33, No. 4, 177-82 (April, 1959).

Calculated in the Born approximation with a diffuse surface optical model potential.

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15569 POLARIZATION AND SCATTERING EXPERIMENT WITH 4 MeV PROTONS. J.Saladin and P.Marmier.
Helv. phys. Acta, Vol. 33, No. 4, 299-328 (1960). In German.

The polarization and differential cross-sections of elastica scattered 4 MeV protons were measured as a function of the scattering angle for Al, Mg, Ti and V. Experimental results fo Al are compared with predictions from optical model theory. It found that good qualitative agreement is obtained. For Al, Mg a Ti, the angular distribution of inelastically scattered protons is quoted and discussed.

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15570 CROSS-SECTIONS FOR PRODUCTION OF Po^{206}, Po AND Po^{210} BY BOMBARDMENT OF Bi^{209} BY PROTO OF 155 MeV. C.Deutsch and M.Lefort.
C.R. Acad. Sci.(Paris), Vol. 250, No. 22, 3624-5 (May 30, 1960). In French.

The absolute cross-sections for production of Po^{206}, Po^{208} a Po^{210} by 155 MeV protons have been measured, using the yield of Na^{24} from aluminium as a monitor. These results are compared with those calculated from Serber's theory of spallation. Second direct interactions are expected to have much lower cross-secti and contribute negligibly to the cross-sections observed.
A.E.I. Research Labor

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15571 SPALLATION REACTION (p, pn), (p, p2n) AND (p, 3 IN GOLD. VARIATIONS OF THE CROSS-SECTION WITH ENERGY. M.Gusakow, Y.Legoux amd H.Sergolle.
C.R.Acad. Sci. (Paris), Vol. 251, No. 1, 70-2 (July 4, 1960). In French.

Cross-sections for the three reactions were measured betw 40 and 155 MeV. The (p,pn) reaction had a maximum of 180 mb 80 MeV, falling to 75 mb at 155 MeV. These values were much higher than theoretical estimates. A maximum of 160 mb was found for the (p, 3n) reaction at 40 MeV. This peak was attributable to compound-nucleus formation; elsewhere the curve agree with direct interaction theory. The (p,p2n) reaction had a maxim of 70 mb at 70 MeV, and agreed well with theory.
A.E.I.Research Labora

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15572 INTERACTION OF HIGH-ENERGY PROTONS AND ALPHA PARTICLES WITH IODINE-127.
I.M.Ladenbauer and L.Winsberg.
Phys. Rev., Vol. 119, No. 4, 1368-75 (Aug. 15, 1960).

Iodine was bombarded with protons ranging in energy from 0.25 to 6.2 BeV and with 0.25, 0.50 and 0.72 BeV alpha particles. Reactions of the type (p,pxn), $(p,2pxn)$, $(p,p\pi^{+})$, $(p,p2\pi^{+})$, $(p,n\pi^{-})$, and $(\alpha,\alpha xn)$ to produce iodine, tellurium, antimony, and caesium isotopes were investigated. Upper limits in the range 0.01 to 0.1 were found for cross-sections of reactions to produce Sb^{127} and Cs^{127}. For Te^{127}, upper limits in the range of 1 to 2 mb were fou This and other studies of reactions in which the product has the same mass numbers as that of the target are discussed in terms the initial interaction. At all incident energies studied, the cross section for the formation of I^{126} via the (p,pn) or $(\alpha,\alpha n)$ reaction significantly higher than that of the other (p,pxn) or $(\alpha,\alpha xn)$ react with the possible exception of $(\alpha,\alpha 4n)$. The (p,pn) and probably t $(\alpha,\alpha n)$ reactions appear to be due primarily to knock-on collision with surface neutrons. The excitation functions for the productio of iodine isotopes by proton bombardment decrease between 0.25 0.72 BeV but remain relatively constant for higher energies. The (p,2pxn) reactions show a similar effect, but with the excitation functions becoming constant at about 2 BeV. These results are c pared with Monte Carlo calculations of the proton-initiated nucle cascade and of the subsequent evaporation of light particles.

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5573

INTERACTION OF HIGH-ENERGY PROTONS WITH INDIUM. D.R.Nethaway and L.Winsberg.

s. Rev., Vol. 119, No. 4, 1375-80 (Aug. 15, 1960).

Indium was bombarded with protons ranging in energy from o 6.2 BeV. Reactions of the type (p,pxn), (p,2pxn), (p,p'), and $^{+}$) that produce isotopes of indium and cadmium were investi d. The excitation functions are constant with experimental r in this energy region with possible exceptions for Cd^{115} and at 1.0 BeV. These results are compared with two types of ulation. In one treatment, the nucleus is considered to be a nerate Fermi gas of nucleons. The cross-sections that were ulated with this nuclear model at 2 BeV are much smaller than xperimental values. There is good agreement at 1 BeV for ides with mass number less than 113. The second treatment s into account the shell structure of In^{115}. The latter calculation he (p,pn) reaction was in good agreement with the experimental lts at 4.1 and 6.2 BeV. The comparison of the experimental lts with the calculated values is discussed in terms of the uacy of the calculations.

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15574

POLARIZATION MEASUREMENTS OF PROTON CAPTURE GAMMA RAYS.

uffert, P.M.Endt and A.M.Hoogenboom.

sica, Vol. 25, No. 8, 659-70 (Aug., 1959).

The linear polarization was measured of eight different gamma s of widely differing energies (E_γ = 0.8 – 8.0 MeV) emitted at onances in the Mg^{24}(p,γ)Al^{25}, Si^{30}(p,γ)P^{31}, and S^{32}(p,γ)Cl^{33} tions. The gamma rays emitted at 90° to the proton beam were pton scattered in a 2 in. NaI scintillation crystal and then de ed in two 4 in. NaI scintillation counters. For six of these t gamma rays previous angular distribution measurements had just two alternatives for either the spin or the parity of the responding resonance level, or for the E2/M1 mixing ratio. The sent polarization measurements have resolved these ambiguities the following results: (a) the 2.85 and 2.86 MeV levels in Cl^{33} e $J^{\pi} = 5/2^{+}$ and $3/2^{-}$, respectively; (b) the 2.69 and 2.24 MeV ma rays observed at the 418 keV Mg^{24}(p,γ)Al^{25} resonance, and 2.85 MeV gamma ray at the 580 keV S^{32}(p,γ)Cl^{33} resonance have dominantly M1 character, while the 8.04 MeV gamma ray at the keV Si^{30}(p,γ)P^{31} reaction has predominantly E2 character. For two remaining gamma rays, the measured polarizations were in eement with known nuclear data.

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15575

ELASTIC SCATTERING OF 13.5 AND 15 MeV DEUTERONS BY NUCLEI. N.Cindro and N.S.Wall.

s. Rev., Vol. 119, No. 4, 1340-4 (Aug. 15, 1960).

15 MeV deuterons were elastically scattered by a number of ments, including Al, Ti, Fe, Cu, Ni, Rh, Pd, Sn (natural and noisotropic), Ta, Au, and Pb. The angular distributions were asured in a 24 in. scattering chamber by means of a NaI(Tl) ntillation detector. The crystal was thick enough to stop 15 MeV terons but too thin to stop protons of the same energy, thus mitting measurement of the (d,d) cross-sections for light ments, where (d,p) reactions play an important role. The distribu s obtained differ sharply from the Rutherford formula $\sigma_c \propto \csc^4(\theta/2)$; st of them, especially those for medium and lighter elements, w pronounced diffraction-like maxima and minima. The energy he beam was degraded to 13.5 MeV and the angular distributions Ni, Sn (natural), and Au measured, showing the same general racteristics.

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15576

DEUTERON STRIPPING WITH POLARIZED DEUTERONS. B.Hird and A.Strzałkowski.

c. Phys. Soc., Vol. 75, Pt 6, 868-74 (June, 1960).

The left—right stripping asymmetry of the ground state, and the st excited state protons groups, were measured at several angles emission, when a Be^{9} target was bombarded with 6 MeV deuterons ch had been polarized by elastically scattering them from carbon. asurements were also made at two angles of the Ca^{40}(d,p)Ca^{41} und-state group asymmetry. The results confirm that polari ion effects in stripping are caused predominantly by the central t of the deuteron and proton distorting potentials. The opposite n of the Be^{9}(d,p)Be^{10} ground-state and first excited-state asym tries enables an unambiguous mixing ratio for the j_n values sible in stripping to the first excited state, to be assigned.

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15577

POLARIZATION IN DEUTERON ELASTIC SCATTERING FROM CARBON AT 6 MeV.

M.A.Al-Jeboori, M.S.Bokhari, A.Strzałkowski and B.Hird.

Proc. Phys. Soc., Vol. 75, Pt 6, 875-9 (June, 1960).

The azimuthal dependence of the cross-section at the second of two deuteron elastic scatterings from carbon was determined at an energy of about 6 MeV. It was found that the left—right part of the asymmetry was small and probably negative, which implies that the vector polarization either changes sign between the two scatterings, or that the tensor polarizations are large. There was no evidence for polarizations of the $\langle T_{22} \rangle$ type.

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15578

A NOTE ON THE ELASTIC SCATTERING OF HIGH ENERGY DEUTERONS BY COMPLEX NUCLEI.

Y.Nishida and H.Tanaka.

Progr. theor. Phys., Vol. 20, No. 6, 976-9 (Dec., 1958).

The diffraction-scattering theory of Akhieser and Sitenko (Abstr. 7383 of 1957) is used to calculate the cross-section for carbon at 156 MeV. Data are fitted better than by the impulse approximation. but still poorly for angles above 15°. R.J.N.Phillips

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15579

STRIPPING EFFECTS IN THE REACTIONS C^{12}(He^{3},p)N^{14} AND C^{12}(He^{3},d)N^{13} AT 13.9 MeV.

J.R.Priest, D.J.Tendam and E.Bleuler.

Phys. Rev., Vol. 119, No. 4, 1295-1301 (Aug. 15, 1960).

Angular distributions were measured for these reactions, using a cyclotron 14 MeV He^{3} beam. Assuming that the (He^{3},p) reaction proceeds by the stripping of a deuteron in either its singlet or triplet state from the He^{3} nucleus, reasonable fits to the angular distributions were obtained using a $[j_L(Qr_0)]^2$ dependence. For the transitions to the 1^{+}, T = 0 ground and second excited states of N^{14}, L = 2, r_0 = 6.0f, and L = 0, r_0 = 5.7f, respectively. This is in accord with a predominant $^{3}D_{1}$ ground state and predominant $^{3}S_{1}$ second excited state configuration for N^{14}. For the transition to the 0^{+}, T = 1 first excited state, L = 0 and r_0 = 5.7f. Butler's stripping theory for the (He^{3},d) reaction with l_p = 1 and r_0 = 5.8f accounts reasonably well for the C^{12}(He^{3},d)N^{13} angular distribution.

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15580

STUDY OF (He^{3},d) AND (He^{3},t) REACTIONS IN LIGHT NUCLEI AT 25 MeV. H.E.Wegner and W.S.Hall.

Phys. Rev., Vol. 119, No. 5, 1654-65 (Sept. 1, 1960).

Angular distributions for the Be^{9}(He^{3},d)B^{10}, Be^{9}(He^{3},t)B^{9}, C^{12}(He^{3},d)N^{13}, and Ca^{40}(He^{3},d)Sc^{41} reactions were measured at 25 MeV and also at 21 MeV for the carbon reaction. It was found that the angular distributions were strongly peaked forward, exhibited diffraction-like structure, and were asymmetric about 90°. The minimal positions of the angular distributions could be fitted with spherical Bessel functions of the appropriate order l, the angular momentum transfer of the ingoing proton. This analysis resulted in the same interaction radius for various levels in each of these reactions. The best-fit interaction radius for each case was 6.17, 5.91, 6.23, and 7.29 fermis respectively. The Butler stripping theory was also fitted to the angular distributions; however, the average decrease of the angular distributions did not agree with the predicted decrease except in one case. The reactions exhibited the general characteristics of a direct process and could be predicted qualitatively with the simple form of direct interaction theories. The experimental equipment and the method of data analysis, using computer codes, is described. The groud-state Q values were measured for the Ca^{40}(He^{3},d)Sc^{41}, Ca^{40}(d,n)Sc^{41}, and O^{16}(He^{3},d)F^{17} reactions. Q values for levels excited by the Ca^{40}(He^{3},d)Sc^{41} reaction were also measured.

539.17 : 539.14

Li^{7}(He^{3},α)Li^{6} AND Li^{7}(t,α)He^{6} REACTIONS. See Abstr. 15523

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15581

NEUTRONS FROM THE He^{3} BOMBARDMENT OF O^{16} AND Mg^{24}. F.Ajzenberg-Selove and K.L.Dunning.

Phys. Rev., Vol. 119, No. 5, 1681-5 (Sept. 1, 1960).

A thin target of magnesium oxide enriched in Mg^{24} was bombarded by 5.52 MeV He^{3} particles. The outgoing neutrons were measured by the method of proton recoils in photographic emulsions. The ground-state Q value of the O^{16}(He^{3},n)Ne^{18} reaction is determined in this experiment to be −3.19 ± 0.04 MeV. The Q-value of the Mg^{24}(He^{3},n)Si^{26} ground-state reaction is 0.08 ± 0.08 MeV. The mass of Si^{26} is then 25.99 232 ± 0.00 0007 a.m.u. (C^{12} standard). In addition, excited states of Si^{26} at 1.78 ± 0.06 and 2.79 ± 0.08 MeV were observed. Angular distributions of these four neutron groups and of the $C^{12}(He^3,n)O^{14}$ ground-state group are also reported: in all but one case, the distributions are peaked in the forward direction.

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15582 ANGULAR DISTRIBUTIONS FOR $C^{12}(\alpha,p)N^{15}$ AT 16.1-19.0 MeV AND $F^{19}(\alpha,p)Ne^{22}$ AT 18.9 MeV.

J.R.Priest, D.J.Tendam and E.Bleuler.
Phys. Rev., Vol. 119, No. 4, 1301-8 (Aug. 15, 1960).

Angular distributions were measured for these reactions using a cyclotron 19 MeV alpha-particle beam. The $C^{12}(\alpha,p_0)N^{15}$ data at 18.0, 17.1 and 16.1 MeV differ markedly from the 19.0, 18.7 and 18.3 MeV data; the latter three are very similar to each other. The differential excitation function at 31.8° (lab.) shows a resonance at 17.5 MeV with a width at half-maximum of ~ 2 MeV. Steep backward peaking is observed in the 16.1 MeV data. Some of the features of the 17.1 and 18.0 MeV data can be represented by Butler's formula for (α,p) reactions using $l = 1$ and $r_0 = 5.9$ and 5.5 f, respectively. For the $F^{19}(\alpha,p)Ne^{22}$ data the cross-sections for the transition to the ground state of Ne^{22} are factors of 10 to 20 less than the cross-sections for the transition to the first excited state of Ne^{22}. This inhibition, together with the $F^{19}(n,d)O^{18}$ data, may be explained by assuming that the two last neutrons of F^{19} are not disturbed in the direct interactions and that they are in a $(d_{5/2}^2)_0$ configuration in Ne^{22}, in a $(d_{5/2}^2)_2$ or $(s_{1/2}^2)_0$ configuration in F^{19}. Using $r_0 = 5.1$ f, Butler's formula accounts reasonably well for the forward peak and the location of the minima of all three angular distributions for the region of angles less than 90°. The angular distributions are all peaked in the backward angles.

539.17

15583 AN ILLUSTRATION OF A TYPE OF TRIPLE CORRELATION MEASUREMENT WHICH CAN BE EASILY INTERPRETED.

A.E.Litherland and G.J.McCallum.
Canad. J. Phys., Vol. 38, No. 7, 927-40 (July, 1960).

The $Mg^{26}(He^4,n\gamma)Si^{29}$ reaction has been used to illustrate the simplifications introduced in the interpretation of triple angular correlations by choosing a target and bombarding particles of zero spin and by observing the emitted particles, in this case neutrons, in a counter fixed at 0° to the beam. The angular correlations of the gamma rays with respect to the incident beam then depend only upon the properties of the final states in the residual nucleus. The angular correlation of the electric quadrupole 2.03 MeV gamma ray is predicted uniquely by theory and this prediction has been verified experimentally. The angular correlations of the 1.28 MeV and 2.43 MeV gamma rays have yielded for the E2/M1 amplitude mixing ratios +0.25 ± 0.05 or −3.4 ± 0.5 and −0.26 ± 0.08 or −1.10 ± 0.16, respectively. In addition, the experiment provides an illustration of the value of the recently discovered technique of neutron—gamma-ray discrimination in an organic scintillator.

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15584 NEUTRON TRANSFER AND THE TUNNELING MECHANISM IN THE BOMBARDMENT OF GOLD BY NITROGEN.

J.A.McIntyre, T.L.Watts and F.C.Jobes.
Phys. Rev., Vol. 119, No. 4, 1331-9 (Aug. 15, 1960).

Measurements were made of the angular distributions of N^{13} nuclei produced in the neutron-transfer reaction $Au^{197}(N^{14},N^{13})Au^{198}$. Fifteen different bombarding energies were studied. It is found that the results can be described in terms of the transfer of a neutron from an N^{14} nucleus moving along a classical trajectory. In particular it is found that N^{14} trajectories with distances of closest approach of $(12.7 \pm 0.5) \times 10^{-13}$ cm give the largest contribution to the transfer process. Further, both the angular and energy dependence of the N^{13} production were compared with the dependences predicted by the tunnelling theory of Breit and Ebel (Abstr. 7667 of 1956; 2627 of 1957); both experimental dependences have been found to be in agreement with this theory.

539.17

15585 NITROGEN INDUCED NUCLEAR REACTIONS IN SODIUM.

R.Nakasima.
Progr. theor. Phys., Vol. 20, No. 5, 625-30 (Nov., 1958).

The nuclear reactions $Na^{23}(N^{14}, \alpha p)P^{32}$ and $Na^{23}(N^{14}, \alpha 2p)Si^{31}$ are analysed on the basis of the compound nucleus model. The ratio of the cross-sections in both reactions at 26 MeV bombarding ion energy seems to be fairly well reproduced in terms of the usual compound nucleus picture, but the absolute values of these cross-sections are anomalously small. Taking account of the effects of depressed Coulomb barrier height, the right orders of magnitu are obtained for the excitation cross-sections of both reactions According to the present investigation, it seems to be rather premature to argue definitely for the presence of a "buckshot" type nuclear reaction, but suggestions and discussions concerni the reaction mechanism of heavy-ion induced nuclear reactions are given.

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15586 INDEPENDENT PARTICLE MODEL AND PHOTO-NUCLEAR GIANT RESONANCE.

E.Eberle, M.Nagasaki and L.Sertorio.
Nuovo Cimento, Vol. 16, No. 2, 260-6 (April 16, 1960).

A calculation of the Migdal mean energy of the photonuclea absorption cross-section is made by using a harmonic oscillato shell model, without complicated mathematical treatment, and t conditions under which this independent particle model can give account of the behaviour of the peak of the giant resonance in th photonuclear reactions are analysed.

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15587 SURFACE EFFECTS IN (γ,n) AND (γ,p) REACTION

V.de Sabbata and A.Tomasini.
Nuovo Cimento, Vol. 16, No. 5, 903-17 (June 1, 1960).

Studies, in the independent particle model, the contribution the photonuclear reactions by the surface of the nuclei; in parti the angular distributions are analysed. The dipole approximati the case of photoneutrons is good, so the angular distributions i symmetrical around $\pi/2$; the presence of an interference term between the transitions $l \to l + 1$, $l \to l - 1$ results in a possible minimum at $\pi/2$ instead of the usual maximum. In the case of photoprotons, as this approximation no longer holds, the closed expression without any expansion in multipoles is considered; s the angular distribution results strongly asymmetrical. Numeri calculations have been carried out at various energies for A = 1 A = 40 and $r_0 = 1.2$, $r_0 = 1.4$. The cross-section results of the o of 10^{-26} cm^2 and the ratio $\sigma(\gamma,p)/\sigma(\gamma,n)$ of the order of unity.

53

15588 ON THE INFLUENCE OF THE PAULI PRINCIPLE OF SHORT-RANGE NUCLEAR FORCES ON THE ABSORPTION OF PHOTONS BY NUCLEI IN THE OSCILLATOR MODEL.

V.A.Él'tekov.
Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1166-8 (Oct., 1959). I Russian. English translation in: Soviet Physics—JETP (New Y Vol. 37(10), No. 4, 830-1 (April, 1960).

Brink (Abstr. 3377 of 1958) has shown that the collective an independent particle descriptions of the nucleus are identical in case of the oscillator potential. By taking into account the effect the Pauli principle and the short range of nuclear forces, it is s that, for real nuclei, the collective model of electric dipole excit can only be applied for the lightest nuclei. For heavier nuclei, t single- and two-particle mechanisms will play the more importa role. J.D.Do

53

15589 γ—p REACTIONS WITH FORMATION OF NUCLEI I THE GROUND STATE.

V.I.Gol'danskii.
Acta phys. Hungar., Vol. 9, No. 1-2, 177-84 (1958). In Russian.

The contributions of individual levels to (γ,p) reactions on B^{10}, C^{12}, N^{14}, O^{16}, S^{32} are estimated from data on the inverse (p, reactions using the principle of detailed balance. The maximum cross-section due to a single level can exceed by a large factor t maximum of the giant photonuclear resonance. The integral cro sections amount to about 10% of the giant resonance integral cros sections. D.W.L.Spr

53

15590 CROSS SECTION FOR THE REACTION $C^{13}(\gamma,n)$ AT 6.4 MeV.

R.D.Edge.
Phys. Rev., Vol. 119, No. 5, 1643-4 (Sept. 1, 1960).

Using radiation from the $F^{19}(p,\alpha\gamma)$ reaction at 874 keV prot energy, the cross-section for the reaction $C^{13}(\gamma,n)$ was found to 94.1 ± 10 microbarns. The neutrons emitted from the target enr in C^{13} were detected by an arrangement of BF_3 counters embedde in wax to give a 4π geometry.

53

15591 PHOTOSTAR PRODUCTION BETWEEN 500 AND 11 MeV.

C.Castagnoli, M.Muchnik, G.Ghigo and R.Rinzi
Nuovo Cimento, Vol. 16, No. 4, 683-9 (May 16, 1960).

Experimental results are reported on the photoproduction of

in photographic emulsions exposed to a high energy
sstrahlung beam of maximum energies between 500 and 1100
The cross-sections, per number of equivalent quanta and per
n are calculated. The results are compared with those which
e derived using experimental values of the cross-sections for
and multiple pion photoproduction. Good agreement is found.

539.17

592

INTERPRETATION OF THE OPTICAL MODEL IN NUCLEAR REACTIONS.

yakawa, T.Sasakawa, K.Tomita, M.Yasuno and M.Yokota.
r. theor. Phys., Vol. 21, No. 1, 85-97 (Jan., 1959).

The theoretical basis of the nuclear optical model is investigated
he elastic scattering of neutrons at low energies. It is argued,
nnection with the statistical mechanics of irreversible proces-
that the characteristic feature of the optical model can be re-
ed by means of wave packets whose energy spread is wide enough
ver many compound levels. The giant resonance of the Lorent-
shape is found to result owing to fluctuations in the imaginary
of the optical potential or the half-width of a giant resonance is
essed by the product of the second moment and the correlation
. The latter is closely related to the concept of portée intro-
d by Bloch (Abstr. 1579, 9377 of 1957) with whom the authors
e the same opinion in many respects. The correlation time is
n by this method to reveal a feature of the fluctuations and can
valuated, if the fourth moment is known.

539.17

5593

STATISTICAL EMISSION OF NUCLEONS IN REACTIONS PRODUCED BY 14 MeV NEUTRONS.

acchini, I Iori and E.Menichella.
o Cimento, Vol. 16, No. 6, 1109-1131 (June 16, 1960).

A number of nuclear reactions for medium and light nuclei
$< Z < 40$), particularly (n, p) reactions with 14 MeV neutrons have
analysed. The expression $n(\epsilon)/\epsilon\sigma^*$, which is proportional to
nuclear level density, is represented fairly well, for ϵ in the
e (4-10) MeV, by an exponential law of the kind $e^{-\epsilon/\theta}$, being
1-1.2) MeV for medium nuclei ($20 < Z < 40$) and $\theta = 1.45$ for
ter nuclei. σ^* has been calculated assuming $r_0 = 1.6 \times 10^{-13}$ cm
protons. On such a basis the ratio $\sigma(n, p)/\sigma(n, n_I)$ is in good
eement with the evaporative model when one considers the Q
es of the reaction and the fact that the residual nucleus is even-
or odd-odd. From such ratio, calculated for even A nuclei, it
ossible to obtain values of the pairing energy Δ in good agree-
t with that calculated by Cameron. Also for (n, 2n), (n, np) and
) reactions on medium nuclei, the evaporative model gives
sfactory results for the interpretation of the cross-section
ations.

539.17

5594

METHOD OF MEASUREMENT OF THE DIFFERENTIAL CROSS-SECTION FOR ELASTIC SCATTERING OF MeV NEUTRONS.

G.Deconninck, G.Demortier and A.Martegani.
. Soc. Sci. Bruxelles I, Vol. 74, No. 2, 136-9 (1960). In French.

The cross-section for scattering by aluminium was measured
.42 barns/steradian at 3° 20', extending thus the range of data
maller angles. Measurements were also carried out at 12° and
and agreed well with previous determinations. The value ob-
ed at 3° 20' fits smoothly on the experimental curve which
iates at small forward angles from the theoretical optical-model
ve.

A.E.I. Research Laboratory

539.17

5595

THE INTERACTION OF SLOW NEUTRONS WITH NUCLEI (REVIEW).

.Vladimirsky, A.A.Panov, I.A.Radkevich and V.V.Sokolovsky.
uclear Energy, Vol. 7, No. 1-2, 169-87 (Aug., 1958). English
slation from: Atomnaya Energiya, Vol. 3, No. 11, 444 (1957).

Methods of producing monochromatic beams for experimental
surement of neutron cross-sections are reviewed. The principal
racteristics of crystal spectrometers, mechanical monochro-
ors, neutron selectors on accelerators and mechanical choppers
se throughout the world are tabulated. Possible measurements
ude the neutron width Γ_n, and the distribution of reduced widths
$E_0^{-1\,2}$, where E_0 is the energy of the level] provides a check on
lear theory. The experimental results are compared with several
retical models. Radiation widths are less well known than neu-
widths, but the experimental results are in qualitative agree-
t with the independent particle model. The liquid drop model
nadequate for predicting fission resonance levels though these
can be roughly related to the radiation width and level spacing. Fission data for a number of nuclides is tabulated and anomalies are discussed.

R.D.Smith

539.17

15596

THE $Al^{27}(n,\alpha)Na^{24}$ REACTION INDUCED BY 15.2 MeV NEUTRONS.

M.Cevolani, S.Petralia, B.Righini, U.Valdrè and G.Venturini.
Nuovo Cimento, Vol. 16, No. 5, 950 (June 1, 1960). In Italian.

The angular and energetic distribution of α-particles resulting from this reaction was determined. The particles were detected with Ilford C-2 and K-0 nuclear emulsions. The reaction chamber was designed so as to obtain a good angular definition, between 80° and 160°. The angular distribution results are remarkably anisotropic; the energetic distribution shows a great number of low energy particles. The temperature of the residual nucleus is calculated and the results obtained are discussed.

539.17

15597

PRECISION DETERMINATION OF THE SLOW NEUTRON ABSORPTION CROSS SECTION OF B^{10}.

G.J.Safford, T.I.Taylor, B.M.Rustad and W.W.Havens, Jr.
Phys. Rev., Vol. 119, No. 4, 1291-4 (Aug. 15, 1960).

The total neutron cross-section of B^{10} was measured at neutron energies between 0.00291 and 0.1 eV with a crystal spectrometer. The B^{10} absorption cross-section was obtained by subtracting the relatively small, known, scattering cross-section from the measured total cross-section. Two samples enriched to 92.84 ± 0.06 and 99.88 ± 0.01 atom % B^{10} were used for these measurements. The B^{10} absorption cross-section obtained with the 92.84% B^{10} sample followed the relation $E^{1/2}\sigma_a = 612.3 \pm 2.4$ barns $eV^{1/2}$ and yielded a value of 3849 ± 15 barns at 0.0253 eV. For the 99.88% B^{10} sample, the B^{10} absorption cross-section obeyed the relation $E^{1/2}\sigma_a = 608.9 \pm \pm 2.3$ barns $eV^{1/2}$ and gave a value of 3828 ± 15 barns at 0.0253 eV. A sample of Argonne-Brookhaven standard normal boron, 19.8 ± ± 0.1% B^{10}, was measured simultaneously. The resulting absorption cross-section for normal boron was $\sigma_a(0.0253\ eV) = 764 \pm 3$ barns and obeyed the relation $E^{1/2}\sigma_a = 121.5 \pm 0.5$ barns $eV^{1/2}$. The average of the results for the two enriched samples yields $\sigma_a(B^{10}) = 3838 \pm \pm 11$ barns at 0.0253 eV and $E^{1/2}\sigma_a(B^{10}) = 610.5 \pm 1.7$ barns $eV^{1/2}$. The ratio of the above values of the absorption cross-sections for B^{10} and normal boron yields a value of 19.9 ± 0.1% B^{10} for the normal sample which is in good agreement with mass spectrometer determinations.

539.17 : 539.16

15598

γ-RADIATION FROM INTERACTION OF 14 MeV NEUTRONS.

W.M.Deuchars and D.Dandy.
Proc. Phys. Soc., Vol. 75, Pt 6, 855-67 (June, 1960).

Time-of-flight techniques were applied to the measurement of γ-ray spectra from the interaction of 14 MeV neutrons with various nuclei. The results for carbon, water, magnesium, aluminium, nickel, copper and lead are presented and are compared with the results from other experiments using lower energy neutrons. Assignments are made for the reaction processes in the light nuclei and isotopic assignments are made for the medium- and heavy-weight nuclei.

539.17

15599

MEASUREMENTS OF THE ENERGY DEPENDENCE OF THE RADIATIVE CAPTURE OF NEUTRONS IN Fe, Ag AND Au IN THE ENERGY REGION UP TO 30 keV.

A.I.Isakov, Yu.P.Popov and F.L.Shapiro.
Zh. eksper. teor. Fiz., Vol. 38, No. 3, 989-92 (March, 1960).
In Russian.

Graphs are shown of the measured cross-sections, against energy, for the (n, γ) reactions in Fe, Ag and Au. For iron the 1/v law was reproduced well for the energy region up to 600 eV. The value of $\sigma_0\Gamma_\gamma = 74 \pm 7$ eV. barn was obtained for the 1180 ± 80 eV level in iron. This level contributes most of the difference (0.12 ± 0.02 barn) between the integrated resonant capture cross-section, $R_\gamma = \int\sigma_\gamma(E)dE/E$, and the value, $R_\gamma(1/v) = 1.1 \pm 0.03$ barn, calculated by extrapolation of the 1/v law from the thermal region to $E = 2 \times 10^6$ eV.

E.A.Sanderson

539.17

15600

A STUDY OF PROTONS EMITTED FROM MEDIUM WEIGHT NUCLEI BOMBARDED WITH NEUTRONS OF 14 MeV.

W.Jack and A.Ward.
Proc. Phys. Soc., Vol. 75, Pt 6, 833-49 (June, 1960).

The energy spectra of protons emitted into a small solid angle in the forward direction from separated isotopes F^{19}, Al^{27}, Fe^{54}, Fe^{56}, Co^{59}, Ni^{58}, Ni^{60}, Cu^{63}, Cu^{65} and Zn^{64} bombarded with 14.1 MeV neutrons were measured with a scintillation counter telescope. The spectra obtained were compared with those measured by Storey et al. (Abstr. 11446 of 1960) who, using 14.1 MeV neutrons, observed the spectra of protons emitted at 90° into a large solid angle. Peaks due to direct interactions are prominent at the higher proton energies, but little evidence is found for systematic structure similar to that observed in the inelastic scattering of protons of energy 11 to 23 MeV. It is suggested that lower energy peaks found in the present spectra, and in those of other workers, corresponding to excitations of the residual nucleus of 7 MeV are not due to protons, but are in fact deuterons mostly from the ground state (n,d) pick-up reaction. The "nuclear temperatures" found from the lower energy protons of the present experiment are in good agreement with those measured by Storey et al.

539.17

15601 CROSS SECTION FOR $^{31}P(n,p)^{31}Si$ REACTION UP TO 5 MeV.

P.Cuzzocrea, G.Pappalardo and R.Ricamo.
Nuovo Cimento, Vol. 16, No. 3, 450-6 (May 1, 1960).

The cross-section for the reaction was measured by the activation method. The average behaviour of the cross-section is the same that was found by others, but the measurements resolve, however, many details and a wide but well defined peak at 3.72 MeV. Resonance peaks were also observed at 2.84 and 3.13 MeV as found previously by Ricamo. There is also evidence of other resonances around 4.5 MeV.

539.17

15602 MEASUREMENTS ON PICK-UP REACTIONS IN ^{31}P AND ^{32}S.

L.Colli, M.G.Marcazzan, F.Merzari, P.G.Sona and F.Tonolini.
Nuovo Cimento, Vol. 16, No. 6, 991-6 (June 16, 1960).

Experimental results on angular distribution of deuterons emitted in the reactions $P^{31}(n,d)Si^{30}$ and $S^{32}(n,d)P^{31}$ are presented. The bombardment was carried out by 14.1 MeV neutrons and only the transition to the ground state is considered. The results are consistent with the simple interpretation that the reaction takes place through a pure pick-up process with zero angular momentum transferred to the residual nucleus.

539.17

15603 CHARGED PARTICLES FROM THE 14 MeV NEUTRON INTERACTION WITH ZIRCONIUM.

Se Hee Ahn, J.R.Hearst, J.H.Roberts and E.N.Strait.
Phys. Rev., Vol. 119, No. 5, 1667-70 (Sept. 1, 1960).

The mechanism of the zirconium (n,p) and (n,np) reactions at 14 MeV was studied experimentally. The energy distribution of particles interpreted as protons was found to peak at about 2 MeV. The cross-section for charged particle emission was found to be 87 ± 22 mb. The angular distribution below 8 MeV is consistent with the compound nucleus model, but above 8 MeV a forward peak is observed.

539.17

15604 THE APPLICABILITY OF THE "Z-LAW" OF FERMI AND TELLER TO NUCLEAR EMULSIONS CONTAINING URANIUM.

G.E.Belovitskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 2, 658-60 (Feb., 1960). In Russian.

Gives a short description and a discussion of an experiment designed to check whether the capture of π^--mesons by the nuclei in uranium-loaded emulsions follows the Fermi—Teller law (Abstr. 3658 of 1947). The results seem to confirm this assumption.

G.Martelli

539.17

15605 MEASUREMENT OF THE RELATIVE NUCLEAR ACTIVITY OF π-MESONS NEAR THE POINT OF CREATION.

B.S.Neganov, L.B.Parfenov and A.A.Tyapkin.
Zh. eksper. teor. Fiz., Vol. 38, No. 6, 1917-18 (June, 1960). In Russian.

The absorption of 70-100 MeV pions by nuclei has been measured as a function of distance from the point of creation. The cross-section is within 15% of geometrical and independent of distance from 3 to 110 cm.

D.W.L.Sprung

539.17 : 539.12

NUCLEAR EXCITATION BY MUONS. See Abstr. 15383

539.17 : 539

MUON CAPTURE IN ^{12}C. See Abstr. 15385

539.17 : 55

NUCLEAR FISSION IN THE EARLY HISTORY OF THE EART
See Abstr. 14323

539

15606 DEPENDENCE OF THE ANGULAR ANISOTROPY OF FISSION ON THE NUCLEAR STRUCTURE.

A.N.Protopopov and V.P.Éismont.
Zh. eksper. teor. Fiz., Vol. 36, No. 5, 1573-4 (May, 1959). In Russian. English translation in: Soviet Physics—JETP (New Yor Vol. 36(9), No. 5, 1116-17 (Nov., 1959).

It is suggested that the observed anisotropy of the fission fragments of heavy nuclei induced by particles of energy 10-40 M may be explained by a thermodynamical interpretation. By plottir $\log\{\sigma(0^\circ)/\sigma(90^\circ)\}$ against T^{-1}, where T is the nuclear temperatur a straight line results, suggesting that $\sigma(0^\circ)/\sigma(90^\circ) \sim \exp(\Delta E\ T)$. The observed dependence of the anisotropy of the fission fragmen is then explained.

R.H.Thon

539

15607 COMPETITION BETWEEN FISSION AND NEUTRON EMISSION IN EXCITED HEAVY NUCLEI.

M.Lindner and A.Turkevich.
Phys. Rev., Vol. 119, No. 5, 1632-43 (Sept. 1, 1960).

The yields of the disintegration products of uranium and thor bombarded with 340 MeV protons were calcaulated from the intranuclear-cascade results of Metropolis et al (Abstr. 654 of 19 together with several alternative treatments of neutron evaporati Several different assumptions concerning fission as a competing process were tested. The yields resulting from these different assumptions were compared with the experimental results of Lin and Osborne (Abstr. 6900 of 1956). The results point to the nonva ance of the quantity Γ_n/Γ_f with change in nuclear excitation in the energy range below 100 MeV. They also indicate that the model used for calculating these high-energy reactions in heavy nuclei is poor for estimating yields of nuclei very close to the target nu (previously noted) and of nuclei with charge much less than that o the target nucleus. This inadequacy appears to be associated wit the cascade stage of the calculation.

539

15608 ANGULAR DISTRIBUTION OF LONG-RANGE ALPHA-PARTICLES; CONNECTED WITH THE FISSI PROCESS.

N.A.Perfilov and Z.I.Solov'eva.
Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1157-9 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 824-5 (April, 1960).

Nuclear emulsions were used to investigate the products of complex fission of U^{235} by thermal neutrons. 600 examples of the case where a long-range alpha-particle was connected with the fission point were studied. The angular distribution of the alpha-particles with respect to the direction of the light fission fragme was calculated. The results are consistent with a liquid-drop behaviour in the fission, the alpha-particles being emitted with appreciable initial velocities and then affected by the Coulomb fie of the two fission fragments. This should cause them to be peake about an angle somewhat less than 90° with respect to the light fragment. In the experiment this angle was 82°. By dividing the alpha-particles into groups according to their energies it was established that those with high energy are less affected by the fi of the two heavy fragments and tend to have an isotropic angular distribution, whereas the low-energy ones are sharply peaked. The existence of an alpha-particle initial velocity may serve as a confirmation of the presence of alpha-particle complexes in heav nuclei.

J.D.Dow

53

15609 SPONTANEOUS FISSION YIELDS OF Cf^{252}.

W.E.Nervik.
Phys. Rev., Vol. 119, No. 5, 1685-90 (Sept. 1, 1960).

A radiochemical investigation was made of the fission yield curve. One source of 1×10^{6}, another of 2×10^{7}, and a third of 7×10^{7} fissions/min were used to obtain the data. Thirty-six radioactive nuclides between mass numbers 77 and 166 were sep ated, identified, and their fission yields calculated. Upper limit were set for nine other nuclides. The fission yield curve has maxima of 6.05% at masses 107 and 141, with a "full width at $\frac{1}{10}$ mum" of each peak of approximately 27 mass units. There is a narrow "trough" with a minimum value of $\leq 8 \times 10^{-3}$% at mass er 124. In addition, while the curve as a whole is symmetrical mass 124, each peak is not symmetrical about its own maxi- being significantly spread toward the most asymmetric fission s. A small fine-structure peak was observed at mass 113. No nce was seen of activities that could be ascribed to ternary n events, upper limits of 10^{-4}% fission yield being set for indi- l nuclides between mass numbers 28 and 72.

539.17

610 INTERPRETATION OF γ-RAY SCINTILLATION SPECTRA FROM FISSION-PRODUCT MIXTURES.

Peirson.

J. appl. Phys., Vol. 11, No. 8, 346-53 (Aug., 1960).

γ-ray scintillation spectra are calculated for the products of ltaneous slow neutron fission of uranium 235. These theoretical tra serve as a basis of comparison with practical measure- of fission-product mixtures. The variation with time, from 28 days, of the photoelectric peak height is shown for the inent fission product activities. A rapid method of half-life ysis is described for use when peaks are inadequately resolved ergy. The effect of spectrometer resolution is discussed.

539.17

5611 NOTE ON A THEORY OF NUCLEAR FUSION REACTIONS IN LOW TEMPERATURE.

arum and S.Matsuo.

hisha engng Rev., Vol. 10, No. 1, 43-8 (June, 1960).

Some improvements and corrections to previous work (Abstr. -70 of 1959) are given. The energies of the bound states of $(pp)^+_\mu$ and $(dd)^+_\mu$ as well as of the $(pd)^+_\mu$ systems (obtained from improved μ-mesonic wave-function and non-adiabatic corrections) tabulated.

NUCLEAR POWER STUDIES

539.17

5612 MINIMUM TOTAL MASS.

J.E.Wilkins, Jr.

lear Sci. Engng, Vol. 6, No. 3, 229-32 (Sept., 1959).

The problem of designing a reactor with minimum total mass osed. This problem is related to that of designing a reactor with imum critical mass. For a simple class of thermal slab reac- s, the known solution of the minimum critical mass problem bles a complete solution of the minimum total mass problem.

539.17

15613 A SIMPLE TREATMENT FOR EFFECTIVE RESONANCE ABSORPTION CROSS SECTIONS IN DENSE LATTICES.

Bell.

lear Sci. Engng, Vol. 5, No. 2, 138-9 (Feb., 1959).

539.17

15614 COMMENTS ON BELL'S APPROXIMATION TO THE RESONANCE INTEGRAL.

C.Kelber and P.Kier.

lear Sci. Engng, Vol. 6, No. 3, 251 (Sept., 1959).

See preceding abstract.

539.17

15615 A MONTE CARLO CALCULATION OF THERMAL UTILIZATION.

A.Rotenberg, A.Lapidus and E.Wetherell.

lear Sci. Engng, Vol. 6, No. 4, 288-93 (Oct., 1959).

A Monte Carlo calculation of thermal utilization is described emphasis on the statistical procedures employed. The reactor del has slightly enriched uranium fuel rods in a hexagonal lattice. moderator is ordinary water but is treated by the code as a rogen gas. General principles are given for using Monte Carlo hniques and it is shown that time reducing methods are as effec- as the better known variance reducing methods in decreasing the t. Good agreement with experimental results was obtained, in- ating that such thermal utilization calculations are feasible and not sensitive to the model of the water molecule.

539.17

15616 MULTIGROUP DIFFUSION CALCULATION OF k_∞ FOR D_2O LATTICES.

N.Tralli, J.Agresta and W.Seibyl.

lear Sci. Engng., Vol. 6, No. 2, 157-9 (Aug., 1959).

An attempt to calculate k_∞ from basic data by a multigroup cedure for a single reactor cell is reported. No details of the method of calculation are given but results are quoted for 1.5 in. diameter natural uranium rods in a square array in D_2O. These are compared with measured values and shown to give better agreement than the conventional methods, but a note added in proof states that further analysis has shown that this better agreement is partly fortuitous.
J.F.Hill

539.17

15617 THE DOUBLE SPHERICAL HARMONIC METHOD FOR CYLINDERS AND SPHERES.

D.W.Drawbaugh and L.C.Noderer.

Nuclear Sci. Engng., Vol. 6, No. 1, 79-81 (July, 1959).

An analysis of the one-velocity transport equation for cylindrical symmetry is given using Yvon's double spherical harmonics method. It is shown that Koenig's treatment of the same problem can be reproduced without the necessity of the use of distribution functions in the evaluation of the product of the singular functions which occur in the analysis.
J.F.Hill

539.17

15618 A NEW APPROXIMATE TREATMENT OF THE ENERGY-DEPENDENT BOLTZMANN EQUATION.

C.R.Mullin.

Nuclear Sci. Engng., Vol. 6, No. 2, 160-2 (Aug., 1959).

The solution of the one-dimensional Boltzmann equation for a non-absorbing purely hydrogenous medium with constant cross-section is considered for the P_1 approximation. A scattering kernel is taken, $f(\mu, u) = 2\mu\exp(-u)$ which gives the exact angular and energy distributions, but these are uncorrelated. The method is compared with the age diffusion and Selengut—Goertzel approximations and shown to give a better approximation to the exact kernel treatment for small lethargy values and also gives a better approximation to the age than the Selengut—Goertzel method.
J.F.Hill

539.17 : 530.16

USE OF GREEN FUNCTIONS IN NEUTRON TRANSPORT THEORY FOR REACTOR CRITICALITY PROBLEMS.

See Abstr. 14546

539.17

15619 PERTURBATION METHODS FOR REACTOR DIFFUSION EQUATIONS.

L.H.Holway, Jr.

Nuclear Sci. Engng, Vol. 6, No. 3, 191-201 (Sept., 1959).

The multigroup diffusion equations are solved formally by expanding the flux in each group in a series of eigenfunctions of the scalar Helmholtz equation. The resulting secular determinant is complicated, but a perturbation solution may be developed for the coupled multigroup equations. In the case of one energy group, the perturbation method chosen reduces to a formula simpler to use and more rapidly convergent than the Rayleigh—Schrodinger formulae. An operator convenient for expressing the boundary conditions at an interface in multiregion reactors is defined. The foregoing techniques are applied to the Fermi age equation for a reflected reactor. Numerical examples are given to illustrate the rates of convergence in typical reactor design problems.

539.17 : 533.7

15620 DIFFUSION PHENOMENA AND ISOTOPE EFFECTS IN THE EXTRACTION OF FISSION-PRODUCT XENON AND KRYPTON FROM IRRADIATED U_3O_8.

T.J.Kennett and H.G.Thode.

Canad. J. Phys., Vol. 38, No. 7, 945-54 (July, 1960).

An investigation of the diffusion of fission-product xenon and krypton from irradiated U_3O_8 powder as a function of temperature has revealed isotopic fractionation and also a double-valued activation energy. The apparent fission yields of Xe^{131} and Xe^{132} show abnormal enrichments of up to a factor of 10. These enrichments appear to be related to the precursor half-lives of xenon. When isotopic fractionation exists, the diffusion results exhibit an extremely low energy of activation.

539.17 : 539.1.07

15621 FLUX PERTURBATION PRODUCED BY ION CHAMBERS AND FISSION CHAMBERS.

A.Sola and W.W.Managan.

Nuclear Sci. Engng, Vol. 6, No. 4, 294-7 (Oct., 1959).

When flux measurements are made in reactors or in piles, large ion chambers are commonly used. The current output of these chambers is read in terms of flux. The chambers depress the flux, however, and a correction should be applied to get the value of the unperturbed flux. The flux perturbation was measured in a large graphite diffusing medium, the Argonne National Laboratory Standard Pile, and found to be between 5% and 25% when measured on the outer surface of typical ion chambers. At about 10 in. from the end of the chamber the perturbation was no longer observed. The flux was measured with a small fission counter which, of itself, did not depress the flux appreciably. To measure the flux depression inside an ion chamber, the latter was simulated by stacking boron-coated aluminium plates above and below the small fission counter used previously. The measurement of the flux depression was found to be in good agreement with that which can be estimated from a calculation in which an exponential absorption is assumed. From these experiments it is concluded that the value of the flux measured with a large boron-coated ion chamber gives an estimation of the flux within 20% to 50% of the unperturbed value depending on the amount of boron in the chamber, while the estimation of the flux is within 5% to 15% when measured with a large U^{235}-coated fission counter. It should be noted that, although these results apply in a graphite diffusing medium, they do not necessarily apply in an absorbing medium such as the heavy concrete which usually surrounds the instrument holes in reactors.

539.17

15622 METHOD FOR OBTAINING A COMPONENT OF APPROXIMATELY COLLIMATED FAST NEUTRONS IN A REACTOR. P.W.Levy.

Rev. sci. Instrum., Vol. 31, No. 8, 823-4 (Aug., 1960).

By locating a uranium slug in the reflector of a graphite reactor, at the edge of the loading, an approximately collimated fast neutron flux is obtained which is at least twice the random background fast flux. The relative intensity of the collimated flux is determined by the separation between slug and sample. Close to the slug the directed flux is high and the collimation poor, and by increasing the separation the collimation is increased but at the expense of intensity. The fast flux in the region where samples are located was determined using the U^{238} fast fission reaction. The spatial dependence of the directed flux can be approximated by an inverse square expression.

539.17

15623 NUCLEAR COMPOSITION OF NATURAL URANIUM FUEL UNDER LONG TERM IRRADIATION IN A THERMAL REACTOR. G.Casini, C.Passarini and A.Prosdocimi.

Energia nucleare, Vol. 7, No. 7, 488-94 (July, 1960).

The fuel composition in a natural uranium and graphite power reactor with regard to the isotopes of uranium and plutonium, and to the main fission products, is analysed by means of the solution of the equation set representing their concentrations; the calculation being carried out by an electronic analogue computer. The dependence of the cross-sections on the neutron spectrum and its changes through the reactor life have been taken into account by the application of the Westcott effective cross sections. The calculation has been repeated at several temperatures in order to analyse the dependence of the concentrations on the actual temperature existing in the different regions of a typical power reactor.

539.17 : 539.21

EFFECTS OF HIGH BURNUP ON NATURAL URANIUM.

See Abstr. 14044

539.17

15624 FIRST "TREAT" RESULTS — MELTDOWN TESTS OF EBR-2 FUEL. E.S.Sowa.

Nucleonics, Vol. 18, No. 6, 122-4 (June, 1960).

EBR-2 fuel pins were subjected to power surges in the TREAT reactor. The pulses gave temperatures up to 1300°C, and lasted 0.2 to 0.5 sec. Below 970°C no damage other than local failure of the sodium bond occurred. Between 970°C and 1015°C failure at one or more points resulted from alloy formation between uranium and the stainless steel can. Above 1015°C the molten uranium was ejected violently from the can. R.D.Smith

539.17

15625 THE DOPPLER COEFFICIENT OF U^{235} FUEL ELEMENTS. M.V.Davis.

Nuclear Sci. Engng, Vol. 3, No. 1, 107-8 (Jan., 1958).

The Doppler temperature coefficient of fuel elements containing a low concentration of U^{235} in U^{238}, and also in aluminium, was measured in the Hanford Test Pile. The method used was to place heated fuel elements in an insulated cartridge in the centre of the Test Pile and measure simultaneously the fuel element temperature and the reactivity change. Several corrections to the results had to be applied. Due to the large magnitude of these, the conclusion is drawn from the results quoted that, at the low U^{235} densities used, the Doppler temperature coefficient is too small to be measured with the Hanford Test Pile. J.F.H

539.

15626 NUCLEAR SAFETY OF IRON-ENCASED FUEL ELEMENTS. N.Ketzlach.

Nuclear Sci. Engng, Vol. 6, No. 3, 187-90 (Sept., 1959).

The maximum safe limits on the storage and shipment of slig enriched fuels be increased by the addition of fixed neutron poison A theoretical study, verified by experiment, is presented to show an infinite amount of 0.95 per cent U^{235} enriched fuel will be subcritical when the fuel elements are encased in tubing at least $\frac{1}{8}$ in. thick. The fuel elements considered are solid rods of 1.34 in. dia- meter and tubular elements of 1.37 in. o.d. and 0.48 in. i.d. Without the tubing it is possible to make as little as four tons of the fu elements considered critical.

539

15627 UNIFORMLY SPACED CONTROL ELEMENTS IN A REACTOR: THEORETICAL BASIS OF APPLICATION OF "ABSORPTION AREA" TO REACTOR CONTROL EVALUATIO L.Tonks.

Nuclear Sci. Engng, Vol. 6, No. 3, 202-13 (Sept., 1959).

A quantitative but simple theory of the control effect of a uniformly distributed set of thermal poison elements in a hydroge moderated bare reactor core has been developed. Starting with pi parallel poison sheets, a zero-flux boundary condition, in a slab core and applying Fourier analysis, it has been possible to genera to any boundary condition, to orthogonally intersecting sets of pois sheets in an infinite rectangular core, to control crosses, and cyli rical rods in regular array, to finite rectangular cores, and to fin cylindrical cores. Each element of the control array is associate with a cross-sectional area A_c within the core and within this are is an easily determined "absorption area" C. To a rather good accuracy the critical k of the controlled core is greater than the k of the uncontrolled core by the ratio $A_c/(A_c - C)$.

539.

15628 THE AGE OF U^{233} FISSION NEUTRONS IN WATER. M.Faber and P.F.Zweifel.

Nuclear Sci. Engng, Vol. 6, No. 1, 81 (July, 1959).

The age to indium resonance of U^{233} fission neutrons in water was calculated with the SLAG code using an IBM-650. The fission spectrum used was a measured one but with the low-energy portic (<1.3 MeV) taken to be the Watt U^{235} spectrum. The age found was 23.0 ± 3 cm^2 compared with a value of 25.3 cm^2 if the Watt spectru was used. J.F.H

539.

15629 NOTE ON POSITION-DEPENDENT SPECTRA. W.B.Wright and F.Feiner.

Nuclear Sci. Engng, Vol. 6, No. 1, 81-2 (July, 1959).

A series of activation experiments to study the spatial transie arising from hydrogenous slab gaps in a number of different medi show that the transients follow a single exponential with a relaxati length not characteristic of the asymptotic spectrum of the mediu A reasonable model which would lead to this result is proposed an it is shown how this can be used (on a $1\frac{1}{2}$ group model) to predict the peaking and relaxation length of a transient generated by a sla gap. J.F.H

539.

15630 DETERMINATION OF TIME BEHAVIOR OF NEUTRO DENSITY AND OF REACTIVITY ON THE ARGONAUT REACTOR. W.R.Kimel, W.E.Carey, F.G.Prohammer and G.C.Baldwin.

Nuclear Sci. Engng, Vol. 6, No. 3, 233-7 (Sept., 1959).

Theoretical and experimental results of the time behaviour of neutron density as a function of both positive and negative step changes in reactivity are presented. The theoretical results are obtained from solutions of the space-independent kinetic equations of a bare thermal reactor based on the Fermi continuous slowing down model and using six groups of delayed neutrons. Theoretical results are given as a function of both positive and negative step changes in reactivity. Experimental results of reactivity worth ar rod calibrations based on pedagogical experiments with the Argon Reactor and verifying the theoretical data are presented together with the details of the pedagogical experiment. An analytically co structed thermal flux function obtained from results of reactivity

urements in the reactor is compared with the actual recorded
rom the reactor. Experimental results obtained with the
naut Reactor indicate that the theoretical kinetic behaviour
cted in this paper are applicable to the actual Argonaut Reactor.

539.17

5631 TRANSIENT BEHAVIOR OF TRIGA, A ZIRCONIUM-HYDRIDE, WATER-MODERATED REACTOR.

Stone, H.P.Sleeper, Jr, R.H.Stahl and G.West.
ear Sci. Engng, Vol. 6, No. 4, 255-9 (Oct., 1959).

Describes the transient behaviour of TRIGA, a light-water-
ed reactor using fuel-moderator elements composed of uranium
zirconium hydride. The large, prompt negative temperature
ficient—an inherent characteristic of these fuel-moderator
ients—limits reactor power transients primarily by means of
-element temperature rise rather than by void formation in the
. Step reactivity insertions of up to 1.6% resulting in peak
ers of 250 MW with no detectable boiling of the core water or
lsion of water from the core.

539.17

5632 ERRORS IN REACTIVITY MEASUREMENTS DUE TO PHOTONEUTRON EFFECTS. C.E.Cohn.

ear Sci. Engng, Vol. 6, No. 4, 284-7 (Oct., 1959).

In reactors having D_2O or Be moderators, the photoneutrons pro-
d by gamma rays from long-lived fission products give rise to
sient effects which could introduce appreciable errors into various
s of reactivity measurements. This paper presents digital com-
r calculations of these effects in D_2O for criticality measurements,
ritical multiplication measurements, rod drops, and rising period
surements. It is found that in some cases appreciable errors are
ible even after one hour waiting periods. Since the Be photo-
ron data cannot be resolved into groups, calculations for Be could
be done. However, the nature of the effects that could be expected
iscussed.

539.17

5633 CALCULATIONS OF FLUX DISTRIBUTIONS IN A BOILING WATER REACTOR.

ukai, A.Shimizu and S.Miyamoto.
lear Sci. Engng, Vol. 6, No. 4, 298-305 (Oct., 1959).

The distributions of neutron flux and void in an orificed core of
oiling water reactor are calculated analytically by use of the re-
on between void generation and power. The analytical method is
cribed, and it is shown that comprehensive surveys of the nuclear
heat performance of a boiling water reactor are possible with
le effort. As an example, the technique of making the void map is
wn. An alternate method for this problem is also described.

539.17

15634 THE TIME-DEPENDENT THERMAL NEUTRON FLUX FROM A PULSED SUBCRITICAL ASSEMBLY.

.Fultz.
clear Sci. Engng, Vol. 6, No. 4, 313-19 (Oct., 1959).

A two-group analysis has been applied to the transient behaviour
the thermal flux in a subcritical assembly which has been given a
ort burst of fast neutrons. This analysis has been applied to
aphite—U^{235} reactors having moderator-to-fuel (C/U) atomic ratios
600, 1200, 2340, and 9550. The results are shown to be in
reement with measurements of the decay of thermal neutrons
en short pulses of fast neutrons are incident on assemblies having
se C/U ratios.

539.17

15635 A STUDY OF SOME MECHANICAL, PHYSICAL, AND CORROSION PROPERTIES OF IODIDE HAFNIUM.

.Goodwin and F.R.Lorenz.
clear Sci. Engng, Vol. 6, No. 1, 49-56 (July, 1959).

Five 30 lb, 4 in. diameter iodide hafnium ingots representing
terial typical of that utilized for the Shippingport PWR were
ricated into strip. Typical tensile, impact, hardness, corrosion
t weight gain, electrical resistivity, and chemical analysis values
re obtained by testing samples from each strip. The effect of
adiation on the impact strength and hardness of hafnium strip
s investigated by subjecting a total of 36 subsized Izod impact
ecimens to irradiation for two cycles in the MTR. A duplicate
oup of nonirradiated specimens was used as a control group. The
chanical, physical, and corrosion property measurements for the
irradiated and irradiated samples showed no physically significant
ferences attributable to chemical analysis. The impact strength
hardness values for the irradiated specimens showed differences
ich were attributable to the integrated neutron flux received.

539.17 : 536.2

HEAT TRANSFER TO WATER FLOWING PARALLEL TO TUBE BUNDLES. See Abstr. 14868

ATOMS

539.18

15636 ISOELECTRONIC EXTRAPOLATION OF ELECTRON AFFINITIES. B.Edlén.

J. chem. Phys., Vol. 33, No. 1, 98-100 (July, 1960).

An expression based on theoretical considerations and containing three adjustable constants is derived for the purpose of extrapolating ionization potentials along isoelectronic sequences. When used to extrapolate electron affinities of the elements of the first and second short period, the formula is found to yield results that are correct within the error limits of the experimental data at present available.

539.18

15637 ANALYTIC WAVE FUNCTIONS. III. THE SPIN-ORBIT, SPIN-OTHER ORBIT, AND SPIN-SPIN INTERACTIONS.

R.G.Breene, Jr.

Phys. Rev., Vol. 119, No. 5, 1615-18 (Sept. 1, 1960).

In Pt I and II (Abstr. 1798, 6159 of 1959), methods and programmes for calculations of certain classes of atomic wave-functions were described. Here the application of the wave-functions so obtained to the calculation of the spin—orbit, spin—other-orbit, and spin—spin interactions is considered. As an example, oxygen with the electron distribution $(1s)^2(2s)^2(2p)^4$ is considered. In first approximation the spin—orbit interaction is supposed diagonal in the wave-functions of the Slater diagram. These calculations then remove the horizontal degeneracy from the diagram. The Coulomb potenetial is assumed for the spin—orbit calculation and the relative contributions of the nucleus and various type electrons to the result are shown. Although the order of the splitting is as observed, the observed asymmetry is not obtained. In second approximation the off-diagonal elements of the spin—orbit interaction are included. The desired asymmetry of the fine structure is obtained, and the agreement with experiment is satisfactory. The spin—other-orbit and spin—spin interactions are calculated for the diagonal first approximation.

539.18

15638 CALCULATION OF ATOMIC ENERGY LEVELS FOR ELECTRONIC CONFIGURATIONS WITH ONE ELECTRON OUTSIDE A NEARLY CLOSED SHELL AND TWO HOLES IN THIS SHELL FOR LS AND PAIR COUPLINGS. N.H.Møller.

Ark. Fys., Vol. 18, Paper 9, 135-57 (1960).

General formulae are given for the energy matrix of electronic configurations with two holes in a nearly closed shell and one electron outside the shell. The results are valid for arbitrary values of the angular momenta both of the electrons in the shell and of the electron outside the shell. If the present formulae are specialized to the configurations p^4p and p^4d they agree with earlier results obtained by Yamanouchi (Abstr. 4522 of 1938; 2092 of 1939), for the case of Russell—Saunders coupling. The present results also apply to the pair coupling scheme of Racah (Abstr. 1783 of 1942) and have been used to investigate the spectrum of singly ionized argon, A II.

539.18

15639 AN INTEGRAL REPRESENTATION OF DISPERSION FORMULA FOR THE HYDROGEN ATOM IN THE GROUND STATE. M.N.Adamov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 315-17 (July 11, 1960). In Russian.

The usual series expansion of the dispersion $\alpha(\omega)$ in terms of ω (angular frequency of the applied electric field) is slowly convergent, especially if ω approaches some $\omega_n = E_n - E_1$. It is shown that

$$\alpha(\omega) = \frac{8}{3} Z^2 [W'(2;\omega) + W'(2;-\omega)]$$

where $W(p;\omega)$ is the Laplace transform of $V(r;\omega)$, such that

$$\chi(r;\omega) = \sqrt{\frac{Z^3}{\pi}}\, r^{-2} e^{-Zr}\, V(r;\omega) \cos\delta$$

is the wave-function, Z is the charge, r and δ are respectively, the radius vector and azimuthal angle of the electron and $W'(p;\omega) = dW/dp$.

J.K.Skwirzynski

539.18

15640 NOTE ON THE SOLUTION OF THE SCHRÖDINGER EQUATION FOR THE GROUND STATE OF THE HELIUM ATOM. H.M.Schwartz.

J. Phys. Radium, Vol. 19, No. 4, 505 (April, 1958). In French.

A correction is made to a paper by Pluvinage (Abstr. 9833 of 1957). P.T.Landsberg

539.18

15641 A COMMENT ON THE PRECEDING NOTE. P.Pluvinage.

J. Phys. Radium, Vol. 19, No. 4, 505 (April, 1958). In French.

539.18

15642 APPROXIMATE ANALYTICAL WAVE FUNCTIONS FOR THE 1sns ^1S STATES OF He AND He-LIKE IONS.

Z.Ritter and R.Pauncz.

J. chem. Phys., Vol. 32, No. 6, 1820-5 (June, 1960).

Calculations have been made for the 1s2s, 1s3s, and 1s4s ^1S states of He and He-like ions, assuming wave-functions of the symmetrized product form u(1) v(2) + u(2) v(1). The results are the best obtained till now using such a functional form, and are even better than some recent calculations which, in addition, use angular correlations. The energy values obtained for He are: 2.1430_7, 2.0603_6, and 2.0332_0 for the 1s2s, 1s3s, and 1s4s ^1S states, respectively. The wave-functions obtained were checked by other criteria besides the energy criterion.

539.18

15643 SIMPLE CONFIGURATION INTERACTION WAVE FUNCTIONS. III. THREE-ELECTRON ATOMIC SYSTEM: AN ANALYTIC STUDY. M.Machacek and C.W.Scherr.

J. chem. Phys., Vol. 33, No. 1, 242-7 (July, 1960).

For Pt I and II, see Abstr. 11481-2 of 1960. An analytic study of the S^2 ground state of lithium-like ions employing Slater-type orbitals to form the open-shell function (1s1s'2s) and the angularly correlated configuration-interaction functions $(1s1s'2s) + \lambda 1s(2p)^2$ and $(1s1s'2s) + \lambda 2s(2p)^2$ is made. Expressions for the wave-function parameters and energy values in terms of the nuclear charge Z are obtained. These are asymptotic expansions for large Z, but they reproduce numerically obtained results for small Z with sufficient accuracy to be useful for many purposes. An unusual result is that, for large Z, the computed energy values are lowest if the orbitals 1s and 1s' are allowed to have complex orbital exponents.

539.18

15644 THE HYPERFINE STRUCTURE OF MANY-ELECTRON ATOMS. G.M.Bukat, A.Z.Dolginov and R.A.Zhitnikov.

Optika i Spektrosk., Vol. 8, No. 3, 285-93 (March, 1960). In Russian.

Describes a calculation of the electron matrix elements which appear in the hyperfine-structure constants of atoms with several equivalent electrons in a partly filled shell. A.Tybulewicz

539.18

15645 APPLICATION OF WAVE FUNCTIONS CONTAINING INTERELECTRON COORDINATES. II. APPROXIMATE ENERGY LEVELS OF ATOMS. P.Walsh and S.Borowitz.

Phys. Rev., Vol. 119, No. 4, 1274-83 (Aug. 15, 1960).

For Pt I, see Abstr. 1468 of 1960. Explores further the use of interelectron coordinates in constructing atomic wave-functions. A simple method is developed for constructing wave-functions of this type which yields surprisingly good values for the energy of a variety of atomic systems, in zero order. The Hamiltonian for the system is split into an unperturbed part, which is separable and which contains the interelectron potentials as well as the electron—nucleus potentials, and into a perturbing term which is always finite and which vanishes whenever an electron is far from the nucleus. The zero-order energies corresponding to this splitting of the Hamiltonian are at least an order of magnitude better for the light atoms than the energies given by the usual Thomas—Fermi theory, and are considerably better than the energies calculated with hydrogenic functions alone in first order.

539.18

15646 PHOTO-IONIZATION OF HELIUM. A.L.Stewart and W.J.Wilkinson.

Proc. Phys. Soc., Vol. 75, Pt 5, 796-9 (May 1, 1960).

Describes a theoretical study of the effect on the calculated oscillator strength of using alternative potentials in the equation for the wave-function of the ionized state. It is shown that the Hartree—Fock potential is clearly superior to the Hartree potential as regards the sensitivity to a change from the dipole length to th dipole velocity formulation, but that the Coulomb potential is as g as the Hartree—Fock potential by this test. J.Hawg

539

15647 NEW THEORETICAL VALUES FOR THE LAMB SHIF A.J.Layzer.

Phys. Rev. Letters, Vol. 4, No. 11, 580-2 (June 1, 1960).

Presents results of calculations of the corrections to the La shift of the orders $\alpha(\alpha Z)^6 \ln^2(\alpha Z)$ and $\alpha(\alpha Z)^6 \ln(\alpha Z)$ for the 1S, 2S, $2P_{1/2}$ and $2P_{3/2}$ states, and an estimate that the term of order $\alpha(\alpha$ is about 10% of the shift due to the logarithmic terms for H (20% He^+). Agreement with experiment is much improved. The metho used is a modification of that of Abstr.6154 of 1959. See also foll ing abstract. J.Hawgo

539

15648 HIGHER ORDER TERMS IN THE LAMB SHIFT CALCULATION. H.M.Fried and D.R.Yennie.

Phys. Rev. Letters, Vol. 4, No. 11, 583-4 (June 1, 1960).

Describes an independent calculation, by a direct extension o the method of Abstr. 6154 of 1959, of the term of order $\alpha(\alpha Z)^6 \ln^2$ which confirms the result for this term in the preceding abstract J.Hawgo

539.18 : 53

THE FIRST IONIZATION POTENTIALS OF THE NEODYMIU AND PRASEODYMIUM ATOMS. See Abstr. 14964

53

15649 POLARIZATION POTENTIAL FOR ELECTRONS IN THE FIELD OF AN ATOM OR ATOM CORE. H.Reeh

Z. Naturforsch., Vol. 15a, No. 5-6, 377-97 (May-June, 1960). In German.

The polarization potential acting on an electron (or positron) in the field of an atom or ion is calculated. Neglecting the excha between the core and valence electrons, the wave-function Φ of t core is written as $\Phi = \Phi_0 + \chi$, where Φ_0 is the unperturbed core wave-function, and χ corresponds to the perturbation of the core the valence electron, and is required to be orthogonal to Φ_0. The perturbation χ of the core is calculated from a stationary perturbation theory of first order for hydrogen-like core orbits of principle quantum number 1 and 2; the corresponding polarization potentials are calculated and shown. An approximation for many-electron cores is given and applied to helium- and neon-like core configurations; simple analytical approximations of the polarizat potential are given for these cases. The results for Si^{4+} are discussed and compared with the results of other authors. The stati ary approximation is criticized. It is shown that the influence of "kinetic terms" enlarges the polarization effects, contrary to the usual supposition. A derivation is given of an expression for the polarization potential acting on two valence electrons for large di tances from the core.

539

15650 RELATIVE QUENCHING CROSS SECTIONS IN THE REACTION OF $Hg(6^3P_1)$ ATOMS WITH ISOTOPIC N_2O MOLECULES. M.Z.Hoffman and R.B.Bernstein.

J. chem. Phys., Vol. 33, No. 2, 526-9 (Aug., 1960).

The N^{14}/N^{15} and O^{16}/O^{18} isotope effects in the $Hg(6^3P_1)$-photosensitized decomposition of nitrous oxide were measured. Obser isotopic fractionation factors, S^0 (interpreted in terms of ratios o rate constants for quenching by $N^{14}N^{14}O^{16}$ versus $N^{15}N^{14}O^{16}$, $N^{14}N^{15}O^{16}$, $N^{14}N^{14}O^{18}$), are related to the ratio of isotopic quenching cross-sections by the equation $Q/Q^* = S^0(\mu/\mu^*)^{1\,2}$, where μ and μ^* are the collisional reduced masses for Hg and the light and heavy isotopic molecules, respectively. The quenching cross-section ratio for $N^{14}_2O^{16}/N^{14}_2O^{18}$ was unity within the experimental uncertainty (±0.1%). The ratios for $N^{14}N^{14}O^{16}/N^{15}N^{14}O^{16}$ and $N^{14}N^{14}O^{16}/N^{14}N^{15}O$ differed from unity by +0.98 and +0.44%, respectively. The order the quenching cross-sections for the isotopic nitrous oxide molecules is thus: $N^{15}N^{14}O^{16} < N^{14}N^{15}O^{16} < N^{14}N^{14}O^{18} \cong N^{14}N^{14}O^{18}$. The imp cations of these observations are briefly discussed.

539.

15651 MEASUREMENT OF THE K-SHELL FLUORESCENT YIELD OF ALUMINIUM.. F.Suzor and G.Charpak.

J. Phys. Radium, Vol. 20, No. 4, 462-5 (April, 1959). In French.

A method permitting a precise measurement for any low atomic number element is described. For aluminium the value $R_K = (4.5 \pm 0.2) \times 10^{-2}$ is found. Proportional counter techniques are employed.

539.18

5652 **MEASUREMENT OF THE K-SHELL FLUORESCENT YIELD OF NICKEL AND CHLORINE AND OF THE ELL OF SILVER.** F.Bertrand, G.Charpak and F.Suzor.
ys. Radium, Vol. 20, No. 12, 956-8 (Dec., 1959). In French.

Using a method described in the preceding abstract the following escence yields were determined. Nickel .... $R_K = 0.38 \pm 0.01$, rine .... $R_K = 0.093 \pm 0.003$, Silver .... $R_L = 0.047 \pm 0.002$.

539.18

5653 **MODERN METHODS OF MEASURING OSCILLATOR STRENGTHS.** H. Van Regemorter.
hys. Radium, Vol. 20, No. 11, 907-14 (Nov., 1959). In French.

Different methods of determining atomic oscillator strengths briefly reviewed. The results of these methods are compared an exhaustive bibliography gives the data now available for each nent.

539.1

.5654 **CALCULATION OF THE PHOTO-IONIZATION CROSS-SECTIONS OF ALUMINIUM AND GALLIUM ATOMS.**
.Vainshtein and G.É.Norman.
ka i Spektrosk., Vol. 8, No. 2, 149-51 (Feb., 1960). In Russian.

Reports a quantum-mechanical calculation of the photo-ioniza- cross-sections (σ) of Al and Ga atoms. The two cross-sections ted against ϵ, the energy of the removed electron in Rydberg s, behaved differently in spite of the similarity of the external lls of Al and Ga. The cross-section of Al decreases almost arly with the energy ϵ ($\sigma = 30 \times 10^{-18}\,cm^2$ at $\epsilon = 0$ and 4 $\times 10^{-18}\,cm^2$ at $\epsilon = 0.12$). In the case of Ga the cross section s more rapidly with the energy ϵ: from $\sigma = 6 \times 10^{-18}\,cm^2$ at 0 it decreases to a minimum ($\sigma = 0$) at $\epsilon = 0.08$ and then it rises in reaching $\sigma = 3 \times 10^{-18}\,cm^2$ at $\epsilon = 0.12$. A.Tybulewicz

539.18

15655 **A POSSIBLE MECHANISM OF ELECTRON EXCITATION IN SLOW ATOMIC COLLISIONS.** E.E.Nikitin.
tika i Spektrosk., Vol. 8, No. 2, 157-9 (Feb., 1960). In Russian.

Where the adiabatic approximation is inapplicable, the simplest -adiabatic process in inelastic atomic collisions is double charge-hange. It was found that, although the double charge-exchange atment of He and Xe collisions gives better results than the sumption of adiabaticity, the simplest form of the charge-exchange atment still failed to give a correct value of the collision cross-ction. A.Tybulewicz

539.18

15656 **CALCULATION OF THE PROBABILITY OF SELF-IONIZATION IN HELIUM AND LITHIUM ATOMS.**
Kh.Propin.
tika i Spektrosk., Vol. 8, No. 3, 300-2 (March, 1960). In Russian.

Deals with calculation of the energies, approximate wave-ctions and probabilities of self-ionization of the $2s^2\ {}^1S$, $2s2p\ {}^1P$, $2p\ {}^3P$, $2p^2\ {}^1S$, $2p^2\ {}^3P$, $2p^2\ {}^1D$ states of helium atoms and $2s^2\ {}^2S$, $1s2s2p\ {}^2P$, $1s2p^2\ {}^2S$, $1s2p^2\ {}^2D$ states of lithium atoms.
A.Tybulewicz

539.18

15657 **THE EXCITATION AND RADIATION MECHANISM OF RARE GASES AND RARE GAS MIXTURES UNDER OMBARDMENT WITH SLOW ELECTRONS.** W.Friedl.
Naturforsch., Vol. 15a, No. 5-6, 398-404 (May-June, 1960). In erman.

A detailed investigation of the decay of electron-excited diation in the rare gases. Spectra for $Xe—O_2$ mixtures are shown d excitation mechanisms are discussed in terms of energy level agrams, etc. J.D.Craggs

539.18

15658 **DETERMINATION OF THE ABSOLUTE VALUES OF THE OSCILLATOR STRENGTHS FROM THE SPECTRAL INE WIDTHS.** V.K.Prokof'ev, I.M.Nagibina and G.P.Petrova.
ptika i Spektrosk., Vol. 8, No. 3, 376-81 (March, 1960). In Russian.

Shows how the absolute values of the oscillator strengths can deduced from the spectral line widths in an arc discharge and plies the method to the oscillator strength of the 2863.33 A line of I; this oscillator strength was found to be 0.08 ± 20%.
A.Tybulewicz

539.18

15659 **PROFILE OF THE H_β HYDROGEN LINE IN ARGON BEHIND A SHOCK WAVE.**
V.N.Alyamovskii and V.F.Kitaeva.
Optika i Spektrosk., Vol. 8, No. 2, 152-6 (Feb., 1960). In Russian.

Analyses the H_β line profile behind a shock wave (temperatures of 12 000-13 000°K and pressures of 0.5-1.5 atm) reflected once from the end of a shock tube. The high-pressure chamber of the shock tube was filled with hydrogen at 80-110 atm and the low-pressure chamber was filled with argon at 0.3-3 mm Hg with 2-5% hydrogen. The velocity of shock waves before reflection at the end of the tube was 3.6-4.8 km/sec. The observed H_β profiles had considerable half-widths (40-60 A), central dips due to the absence of the Stark component, and a slight asymmetry (~ 6%). They agreed quite well with Holtmark's theoretical profiles. From the recorded profiles and half-widths the concentration of charged particles in argon behind a reflected shock wave was found to be of the order of $10^{17}\,cm^{-3}$ in agreement with the values calculated using Saha's equation (assuming that argon is an ideal gas and that it is in thermal equilibrium).
A.Tybulewicz

539.18

15660 **EFFECTS OF ADDED GASES ON THE SENSITIZED FLUORESCENCE SPECTRUM OF A Hg—Tl MIXTURE.**
R.A.Anderson and R.H.McFarland.
Phys. Rev., Vol. 119, No. 2, 693-700 (July 15, 1960).

An investigation of the sensitized fluorescence of a mercury—thallium mixture without and with the addition of argon and helium gases is discussed. Data taken without the addition of foreign gases are used to extend the theory of Frish and Karaulinya to a Hg—Tl mixture. Relative collision cross-sections for the excitation of the thallium energy states, $9\,{}^2S_{1/2}$, $7\,{}^2D_{5/2,3/2}$, $8\,{}^2S_{1/2}$, $6\,{}^2D_{5/2}$, and $6\,{}^2D_{3/2}$ were calculated for Hg—Tl collisions. Data taken with the addition of argon and helium gases are given to indicate the variation of the intensity of the thallium lines as a function of argon and helium gas pressures at one constant thallium and three mercury temperatures. The explanation of the results depends on the role of mercury $6\,{}^3P_1$ excited atoms, metastable atoms, and mercury molecules in collision with thallium atoms for energy exchange, and also requires the use of Winans' partial selection rule and other generally accepted ideas concerning energy transfer, emission, and absorption.

539.18

15661 **THE ISOTOPIC SHIFT IN THE SPECTRUM OF MOLYBDENUM.** Yu.P.Dontsov.
Optika i Spektrosk., Vol. 8, No. 4, 446-51 (April, 1960). In Russian.

The spectra were excited in discharge tubes with hollow cathodes cooled with liquid nitrogen. The tubes were filled with spectrally pure argon at 0.5 mm Hg and with samples enriched with one of the following even-even isotopes: Mo^{92}, Mo^{94}, Mo^{96}, Mo^{98}, Mo^{100}. The volume effect in the isotopic shift of Mo was much greater than the mass effect and the isotopic components were not equidistant. A.Tybulewicz

539.18

15662 **ISOTOPIC SHIFT IN THE SPECTRUM OF NEODYMIUM.** Yu.P.Dontsov, V.A.Morozov and A.R.Striganov.
Optika i Spektrosk., Vol. 8, No. 6, 741-5 (June, 1960). In Russian.

The samples used consisted of separated isotopes: Nd^{142}, Nd^{144}, Nd^{146}, Nd^{148}, Nd^{150}. A Fabry—Perot interferometer and a hollow-cathode discharge tube were employed to obtain the following isotopic shifts for 16 lines between 4689 and 6486 A; $\Delta\nu$ (142-144), $\Delta\nu$ (144-146), $\Delta\nu$ (146-148), $\Delta\nu$ (148-150). The relative shifts of the Nd I and Nd II lines were practically identical and independent of wavelength. The mean relative shifts were 1.00 (142-144), 0.87 (144-146), 1.04 (146-148), 1.42 (148-150). The inequality of the relative shifts may be due to non-uniform variations of the amplitudes of the zero vibrations of the nuclear quadrupole moment.
A.Tybulewicz

539.18

15663 **INTENSITY RATIO IN THE "FORBIDDEN" DOUBLET λ 2958 AND λ 2972 Å. U. IN THE SPECTRUM OF ATOMIC OXYGEN.** L.Liszka and H.Niewodniczański.
Acta phys. Polon., Vol. 17, No. 9, 345-51 (1958).

The aim was to discover in the O I spectrum the appearance of the "forbidden" electric quadrupole line 2958 A and afterwards to measure the ratio of the intensity of this line to that of the second line in the "forbidden" O I doublet, which is the previously observed magnetic dipole line 2972 A. This doublet was obtained in the radiation of a specially constructed discharge tube filled with a mixture of helium and oxygen. Optimum conditions of the discharges were found in order to obtain the much fainter component of the "forbidden" doublet, the line 2958 A. The intensity ratio of these "forbidden" lines in the doublet was experimentally found to be 1 : 45 ± 30%, which is in agreement in order of magnitude with the theoretically expected ratio 1 : 100.

539.18

15664 SPECTRUM AND TERM SYSTEM OF TREBLY IONIZED SILICON, Si IV. Y.G.Toresson.

Ark. Fys., Vol. 17, Paper 12, 179-92 (1960).

The spectrum of trebly ionized silicon has been studied in the region 10 000-400 A by using a sliding spark in vacuum. A total of 58 spectrum lines above 2000 A have been measured and classified, 34 of which had not been observed before. In the vacuum ultraviolet region some previously known multiplets have been accurately measured. New levels have been added to those previously known, and the whole term system has been recalculated on the basis of the new measurements. The narrow splittings of the terms 3d, 4d and 5d^{2}D have been determined.

539.18

15665 NEW DESCRIPTION OF THORIUM SPECTRA. R.Zalubas.

Nat. Bur. Stand. Monogr. 17, 103 pp. (1960).

Wavelengths and estimated intensities in electrodeless lamp and spark sources are presented for 15121 lines of Th I, Th II, Th III, and Th IV in the spectral range from 2000 to 11 550 A. Previously published interferomatric values are included in this table rounded off to three decimal places.

539.18 : 523.87

15666 LABORATORY HIGH-EXCITATION RELATIVE f-VALUES FOR TITANIUM I.

R.Hefferlin, B.Cobb, D.Hall and C.Lehman.

Astrophys. J., Vol. 132, No. 1, 259-63 (July, 1960).

It was found that a steady arc could be maintained between pure titanium electrodes 1 cm square by using 15 A at 28 V, d.c. The spectrum of this arc has been studied with a previously developed scanning and recording system. From repeated scans of the spectrum it has been found that the excitation temperature of the arc is 4450° ± 150°K and that all lines of lower-state energy 2.0 V or below are self-absorbed the same amount for a given unabsorbed intensity I_0, except that lines terminating on the ground states are self-reversed an additional amount $\Delta \log I = -0.5$. Lines of lower-state energy 2.5 V or above were then measured on the same records of the spectrum, and calculations of f-values were made. These laboratory f-values are compared herein with f-values for some of the same lines which had been derived from stellar spectra.

539.18

15667 ISOTOPIC SHIFTS IN THE ARC SPECTRUM OF TUNGSTEN. J.Blaise and G.Gluck.

J. Phys. Radium, Vol 20, No. 4, 466-9 (April, 1959). In French.

From the line 5642 A ($d^4\,{}^5s^2\,D_1-d^4\,sp\,{}^7F^0_0$), the relative isotopic shift of the four abundant isotopes of W has been determined. The relative position of W^{180} with respect to W^{186} and W^{184} has been measured in four strong lines of the type $d^4\,s^2-d^4\,sp$. The relative positions of the isotopes are: (186) : 0; (184) : 1; (183) : 1.54 ± 0.02; (182) : 2.13 ± 0.02; (180) : 2.92 ± 0.05. The abnormal position of W^{182} implies the inversion of the phenomenon of odd-even staggering. The measurement of the isotopic shift of several hundred lines allows a further classification of the arc spectrum where 6 types of transitions are already recognized. The value of the isotope shift constant for the pair of isotopes $W^{184}-W^{186}$ is $\beta C_{exp} = 117 \pm 20$ mK.

539.18

15668 INVESTIGATIONS ON THE USE OF KATHAROMETERS FOR ISOTOPIC ANALYSIS.

R.Bucur, I.Mercea and V.Mercea.

Rev. de Physique (Bucarest), Vol. 5, No. 1, 5-22 (1960). In German.

The conditions of highest sensitivity were examined using various arrangements of the heating wire. Concentrations of 1.12×10^{-5} parts of deuterium in hydrogen, 3.33×10^{-4} parts of O^{18} in O^{16}, 6.75×10^{-4} parts of N^{15} in N^{14}, and 2.15×10^{-4} parts of Ne^{22} in Ne^{20} were determined. R.Schnurmann

539.18 : 533.7

ISOTOPE SEPARATION IN THERMAL DIFFUSION COLUMN.

See Abstr. 14690

539

15669 MASS OF THE NUCLIDE Pu^{239}. R.A.Demirkhanov, T.I.Gutkin and V.V.Dorokhov.

Zh. eksper, teor. Fiz., Vol. 36, No. 5, 1595-6 (May, 1959). In Russian. English translation in: Soviet Physics—JETP (New Yor
Vol. 36(9), No. 5, 1134 (Nov., 1959).

A determination of the mass of the nuclide Pu^{239} was carried
using a mass spectrometer with a resolving power of 60 000-80 00
The method adopted was to measure the mass difference between
nuclide and certain organic compounds, whose masses had previo
been carefully determined. The average value obtained from two
such measurements is 239.128784 ± 165. The result is discussed
relation to values deduced from nuclear-reaction data.
J.D.Dow

539.18 : 539.

15670 CONCERNING VERY-HEAVY ISOTOPES OF HYDROG AND HELIUM. V.I.Gol'danskii.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1637-9 (May, 1960). In Russian.

The stabilities of the isotopes H^5, H^7 and He^8 to neutron emis
are investigated from the standpoint of neutron pairing energies.
Certain energy levels are "predicted" as conditions for the stabilities of these isotopes. The available experimental evidence see
to favour instability for H^5, but is insufficient to permit any firm conclusions. Some possible ways of looking for these isotopes, experimentally, are suggested. E.A.Sanders

539

15671 DESIGN OF A MAGNETIC ATOMIC BEAM RESONANCI APPARATUS. D.v.Ehrenstein, G.Fricke and P.Pietsch

Z. angew. Phys., Vol. 12, No. 5, 193-202 (May, 1960). In German.

Describes a method for determining the optimum parameters
a Rabi-type resonance apparatus. Ionization by electron impact i
used for detection. An estimate of the influence of the inhomogen
of the "two-wire field" used for deflection shows that tripling the homogeneity leads only to a 40% increase in the signal. H.M

539.18 : 538

15672 ATOMIC BEAM E—H GRADIENT SPECTROMETER. B.Bederson, J.Eisinger, K.Rubin and A.Salop.

Rev. sci. Instrum., Vol. 31, No. 8, 852-3 (Aug., 1960).

A novel atomic beam magnetic substate selector is described.
potential difference is applied to the insulated pole faces of an inhomogeneous magnet. The resulting E and H fields are then appr
mately congruent throughout the gap region. A beam atom experi
ces forces due to its effective magnetic moment and induced elect
ric moment which can be made to balance for particular magnetic substates, independent of the atomic velocity. State-selected bea
of reasonable intensity and purity can thus be obtained.

539

15673 CALCULATION OF THE ELASTIC SCATTERING WIT OUT POLARIZATION OR EXCHANGE [EFFECTS] OF A ZERO SPEED ELECTRON BY A NEUTRAL ATOM OF SODIUM IN THE GROUND STATE. A.Salmona and P.Frenkiel.

J. Phys. Radium, Vol. 20, No. 4, 492-3 (April, 1959). In French.

The calculation of the collision cross-section, neglecting the effects of polarization and exchange.

539

15674 VARIATIONAL TREATMENT OF ELECTRON—HYDROGEN ATOM ELASTIC SCATTERING. S.Geltn

Phys. Rev., Vol. 119, No. 4, 1283-90 (Aug. 15, 1960).

The Hulthen—Kohn variational method is applied to the elasti
scattering of electrons by hydrogen atoms. The trial function use
is of a nonseparable form, allows for the virtual excitation of the 2s and 3s states, and contains a scaling parameter which is allow
to vary. The resulting scattering lengths and S, P, and D singlet and triplet phase shifts are compared with the results of other calculations, and reasons are given for expecting them to be of improved accuracy.

539

15675 ELASTIC SCATTERING OF LOW ENERGY ELECTRO BY ATOMIC HYDROGEN. F.B.Malik and E.Trefftz.

Z. Astrophys., Vol. 50, No. 2, 96-109 (1960).

The elastic scattering cross-section for an electron in the fi
of a neutral hydrogen atom is calculated for energies between 0 a
1.5 Rydbergs (i.e. 0 to 20 eV). The calculation is done numerical

e Hartree—Fock procedure. Polarization is taken account of by ential of the form

$$V_p = -\alpha/(2[a + r^4])$$

9/2, a = 25 in atomic units). For energies >~0.3 Rydberg (4 eV) ange effect as well as polarization increase the cross-section, for very small energies (<~0.15 Rydberg = 2 eV) the cross-on is lowered. Phase shifts and cross-sections for the different s are shown, and a comparison with experimental results is e. There is good agreement between the measurements of kmann, Fite and Neynaber (Abstr. 6174 of 1959) and the present e, including exchange and polarization.

539.18 : 539.12

SCATTERING OF PHOTONS BY THE K-LEVEL ELECTRONS MERCURY. See Abstr. 15314

539.18 : 539.12

COMPTON CROSS-SECTION OF Pb. See Abstr. 15313

539.18

15676 ENERGY OF INTERACTION OF TWO HELIUM ATOMS. N.Moore.

hem. Phys., Vol. 33, No. 2, 471-80 (Aug., 1960).

The interaction energy of two helium atoms in the ground state alculated as a function of internuclear separation. Use is made variational trial state function developed in analogy with schfelder and Linnett's treatment (1950) of the hydrogen—hydrogen raction. The results are in good agreement with the best previ- treatments in the repulsive region as well as with the results of en, Margenau, and Page in the neighbourhood of the van der Waals imum; in addition, information is obtained concerning the antaneous mutual polarization of the two atoms.

539.18

15677 THE INTERACTION BETWEEN TWO NORMAL HELIUM ATOMS. A CONSISTENT TREATMENT.

ashino and S.Huzinaga.

ogr. theor. Phys., Vol. 20, No. 5, 631-42 (Nov., 1958).

A consistent variation calculation is made of the interaction rgy between two normal helium atoms from the repulsive region he van der Waals region. The LCAO MO method within single figuration approximation is used and two variation parameters included in the wavefunction in such a way that the bonding and anti-bonding orbitals can be deformed separately. The result he calculation is satisfactory.

539.18

15678 PHOTOEFFECT FROM THE L SHELL

R.H.Pratt.

ys. Rev., Vol. 119, No. 5, 1619-26 (Sept. 1, 1960).

The differential cross-section for photoeffect from an atomic ll is shown to be almost independent of principal quantum number, rt from normalization, for energies well above threshold. The h-energy limits of the total cross-sections for the three L sub- ells are calculated exactly with methods previously applied to the shell (Abstr. 5892 of 1960), and extrapolations are made to cover entire high-energy region. A procedure is indicated to account the effects of electron screening. It is found that the contribution m the p subshells is not negligible in heavy elements. Agreement h experiment is good.

539.18 : 529

CAESIUM ATOMIC CLOCKS. See Abstr. 14480

MOLECULES

539.19

15679 A NEW VARIANT OF THE METALLIC MODEL OF A MOLECULE. L.A.Borovinskii.

ptika i Spektrosk., Vol. 8, No. 2, 191-8 (Feb., 1960). In Russian.

Proposes a metallic model for molecules with chains of con- gated bonds. The molecular cores, consisting of nuclei and -electrons, are modelled by a fixed charge distributed uniformly ong a line equal in length to the conjugated-bond chain. Motion of -electrons in the field of the core is considered and variables re- esenting longitudinal and transverse motion of π-electrons are separated by an approximate method. The calculated absorption wavelengths agree quite well with the experimental data for some organic molecules. A.Tybulewicz

539.19 : 532.7

CALCULATION OF THE PAIR CORRELATION FUNCTION. See Abstr. 14647

539.19

15680 THEORY OF HYPERFINE INTERACTIONS IN AROMATIC RADICALS.

A.D.McLachlan, H.H.Dearman and R.Lefebvre.

J. chem. Phys., Vol. 33, No. 1, 65-70 (July, 1960).

The relation $a_H = Q\rho$ between the ring proton isotropic hyperfine splitting a_H and the unpaired spin density ρ on the carbon atom in an aromatic hydrocarbon radical is derived under even more general conditions than McConnell and Chesnut's (Abstr. 2016 of 1958). There are only three essential assumptions in the new theory: (a) that $\sigma-\pi$ exchange interaction is small; (b) that an antisymmetrized product $U(\pi)V(\sigma)$, which allows $\pi-\pi$ and $\sigma-\sigma$, but not $\sigma-\pi$ correlations, is a good first approximation to the ground-state electronic wave function; and (c) that $U(\pi)$ is formed exclusively of π-orbital configurations, and $V(\sigma)$ exclusively of σ ones. In the framework of this theory the unpaired spin density in the molecular plane arises entirely from σ-electron excitations. The general relation $a_N = \mathrm{tr}(Q^N\rho)$ holds for any nucleus N, including C^{13} and N^{14}, which lies in the molecular plane. Here ρ is the π-electron spin-density matrix, and Q^N a hyperfine coupling matrix, whose elements depend on $\sigma-\pi$ exchange integrals and excited σ triplet states. The diagonal elements of Q^N for C^{13} are estimated in a simple way to be + 41 G for the same carbon atom and −14 G for each next neighbour, while experimental data fit the values + 41 and −6.9 G.

539.19

15681 SOME NEGLECTED SUBCASES OF PREDISSOCIATION IN DIATOMIC MOLECULES. R.S.Mulliken.

J. chem. Phys., Vol. 33, No. 1, 247-52 (July, 1960).

The theoretically expected effects of the Franck—Condon factor in predissociation in diatomic molecules are examined qualitatively for cases in which the potential-energy curve of the predissociating electronic state crosses that of the predissociated state at an internuclear distance r_c near or less than the equilibrium distance r_e of the latter state. It is shown that the incidence of predissociation as a function of the vibrational and rotational quantum numbers v and J should be quite different in such cases than in the more familiar cases where $r_c > r_e$. Various subcases of Herzberg's cases a, b, c depending on the relation of r_c to r_e are specified and designated. Some probable examples of known predissociations where $r_c < r_e$ are discussed. The need for further quantitative studies is emphasized.

539.19

15682 ON THE DISSOCIATION OF POLYATOMIC MOLECULES. R.J.Rubin and K.E.Shuler.

J. chem. Phys., Vol. 33, No. 2, 438-43 (Aug., 1960).

The dissociation of a simple model of a linear four-atomic molecule is treated classically by considering the motion of configuration points in the configuration space of the molecule. The usual configurational criterion for dissociation, i.e., the crossing of a critical surface in configuration space, is used. The specific problem studied here is the effect of the recrossing of a critical surface by a configuration point corresponding to the "healing" of a "dissociated" bond. It is shown that, for the model considered here, the above effect results in a greater probability of breaking of the exterior bonds as compared to the interior one.

539.19 : 541.14

15683 KINETICS OF EXCITED MOLECULES. II. DISSOCIATION PROCESSES. G.B.Porter and B.T.Connelly.

J. chem. Phys., Vol. 33, No. 1, 81-5 (July, 1960).

For Pt I, see Canad. J. Chem., Vol. 36, No. 12, 1640 (Dec., 1958). A detailed calculation of the rate of dissociation of an electronically and vibrationally excited molecule (photochemical dissociation) is compared with the experimental data for ketene. The results are consistent with unimolecular reaction rate theory. However, the data are not accurate enough to provide unambiguous values for the parameters in the theory.

539.19

15684 TRANSFERABILITY OF UREY—BRADLEY FORCE CONSTANTS. III. THE VINYLIDENE HALIDES.

J.R.Scherer and J.Overend.

J. chem. Phys., Vol. 32, No. 6, 1720-33 (June, 1960).

For Pts I-II, see Abstr. 11514-15 (1960). Force constants have been calculated by a least-squares method for vinylidene bromide and vinylidene fluoride using complete deuterium isotopic data and a Urey—Bradley potential function. The results show that the "C=C stretching" and "CH_2 scissors" modes are not pure vibrations but exhibit appreciable coupling between C=C stretching and CH_2 bending coordinates. Further the molecules within the vinylidene-halide series do not seem to have constant normal coordinates and hence the frequency differences are not entirely associated with changes in the force field. It follows that in molecules of this type, it is dangerous to infer changes in bond strength from observed frequency shifts except with the aid of a complete normal-coordinate analysis.

539.19

15685 TRANSFERABILITY OF UREY—BRADLEY FORCE CONSTANTS. IV. METHYL HALIDES.

J.Overend and J.R.Scherer.

J. chem. Phys., Vol. 33, No. 2, 446-52 (Aug., 1960).

For Pt III, see preceding abstract. Urey—Bradley force constants have been fitted by least squares to the vibrational frequencies of CH_3F, CH_3Cl, CH_3Br, CH_3I, and their fully deuterated isotopes. Both observed and zeroth-order frequency data have been used and the corresponding sets of force constants have been compared.

539.19

15686 A FORM OF THE "MORSE" WAVE FUNCTION AND AN EXTENSION OF M.E.PILLOW'S METHOD.

R.Grandmontagne.

J. Phys. Radium, Vol. 19, No. 2, 151-2 (Feb., 1958). In French.

Two forms of the Morse wave function are given for the N_2^+ molecule with quantum numbers $v = 11$ and $v = 17$. They are compared with approximate curves drawn according to Pillow's method (Abstr. 9631 of 1951) after slight modifications.

539.19

15687 TABLE OF ENERGY LEVELS OF A SLIGHTLY ASYMMETRICAL TOP ROTOR.

N.Jannuzzi and S.P.S.Porto.

J. molecular Spectrosc., Vol. 4, No. 6, 459-68 (1960).

Tables of energy levels are presented for near symmetrical top rotors for the nondegenerate levels. The values are given as a function of $\epsilon = (\kappa + 1)/(\kappa - 3)$, where $\kappa = (2B - A - C)/(A - C)$. The continued fraction method approximation was used.

539.19

15688 A NEW [EMPIRICAL] POTENTIAL FUNCTION FOR DIATOMIC MOLECULES. B.Fogarassy and G.Németh.

Acta phys. Hungar., Vol. 11, No. 3, 265-75 (1960).

The conditions to be satisfied by such a function are determined and some of the potential functions used previously are briefly discussed. It is shown that the solution of the Schrödinger equation for the Morse potential is not exact. The potential function suggested here satisfies the required conditions and leads to an exact solution of the Schrödinger equation. The considerations are restricted to the vibration spectrum.

539.19

15689 INTENSITIES OF ROTATION LINES IN ABSORPTION BANDS FOR SYMMETRIC MOLECULES OF THE TYPE AB ... XYZ_3. H.M.Hanson and H.H.Nielsen.

J. molecular Spectrosc., Vol. 4, No. 6, 468-76 (1960).

The interaction of vibration and rotation is considered in the computation of the intensities of rotational lines in the band spectra of the general polyatomic molecule. The calculation utilizes the contact transformation method outlined in an earlier paper by the authors. The general result through first order of approximation is then applied to the case of the axially asymmetric molecule of the type AB ... XYZ_3. Relations for the intensities of the lines in the types of band observed are obtained. It is found also, to this order of approximation, that the usual selection rules are observed.

539.19 : 532.7

ROTATIONAL DIFFUSION CONSTANT OF ROD-LIKE MOLECULE. See Abstr. 14583-4

539

15690 THE EFFECT OF AN INTERACTION WITH THE ENVIRONMENT ON THE FERMI RESONANCE IN MUL ATOMIC MOLECULES. V.L.Strizhevskii.

Optika i Spektrosk., Vol. 8, No. 2, 165-70 (Feb., 1960). In Russi

It is shown that in pure substances and weak solutions an inte action with the environment should always lead to partial equalization of the intensities of the resonating components. If a molec with resonating levels is non-polar, then this equalization will be greater in a pure substance than in many solutions. The latter co clusion is well supported by experimental results. A.Tybulew

539

15691 THE THEORY OF THE USE OF DEPENDENT COORDINATES IN THE PROBLEM OF MOLECULAR VIBRATIONS. I.V.Rigina and I.N.Godnev.

Optika i Spektrosk., Vol. 8, No. 2, 171-5 (Feb., 1960). In Russian

Gold, Dowling and Meister (Abstr. 6374 of 1958) reported a calculation of the rotational-vibrational spectra of multiatomic molecules by transforming independent into dependent coordinate and obtaining amplitude equations with singular matrices. It is shown here that such amplitude equations are not essential and m general equations are derived from Lagrange's equation with constraints; these general equations can be used to deal with molecul vibrations in dependent coordinates. A.Tybulew

539

15692 DEVELOPMENT OF A METHOD OF DETERMINING THE RELAXATION TIME USING A SPECTROPHONE. II. ELIMINATION OF THE INSTRUMENTAL PHASE SHIFTS.

P.V.Slobodskaya and E.S.Gasilevich.

Optika i Spektrosk., Vol. 8, No. 5, 678-85 (May, 1960). In Russia

For Pt I, see Abstr. 4186 of 1960. Discusses sources of systematic errors which occur in determination of the relaxation time of the vibrational states of molecules by means of a spectrophone (a gas analyser with an optico-acoustic receiver). Methods elimination of the instrumental phase shifts are described.

A.Tybulewi

539.

15693 CALCULATION OF DERIVATIVES OF THE FREQUE CIES AND FORMS OF NORMAL VIBRATIONS OF MOLECULES IN THE SYMMETRICAL CASE. L.S.Mayants.

Optika i Spektrosk., Vol. 8, No. 2, 199-205 (Feb., 1960). In Russi

Deals with methods of calculation of derivatives of the freque and forms of normal vibrations using separate equations for each type of symmetry. It is shown that derivatives can be found also the case of degenerate vibrations, even when a change of the para meter considered disturbs the molecular symmetry.

A.Tybulew

539

15694 THE EXCITATION OF MOLECULAR VIBRATION AN ROTATION BY IMPACT OF SLOW ELECTRONS.

H.S.W.Massey.

Phil. Mag. (Eighth Ser.), Vol. 4, 336-40 (March, 1959).

A new approximate formula is derived for the cross-sections for excitation of molecular vibration and rotation by impact of sl electrons. Account is taken of the fact that in such impacts the incident electron is moving much faster than the nuclei in the mol cule while its wave-function suffers considerable distortion by the molecular field.

539

15695 ROTATION-VIBRATION INTERACTION IN ELECTRO TRANSITIONS. APPLICATION TO ROTATIONAL "TEMPERATURE" MEASUREMENTS. T.C.James.

J. chem. Phys., Vol. 32, No. 6, 1770-5 (June, 1960).

The effect of rotation-vibration interaction on line intensities in electronic transitions in diatomic molecules is discussed. It is shown that this effect is closely related to the variation in the electronic transition moment with internuclear distance. The relation of this to the determination of rotational temperatures is di cussed, using the OH radical as an example. It is shown that a neglect of this interaction can lead to the observation of apparent abnormal temperatures.

539.19

5696 APPLICATION OF SYMMETRY PRINCIPLES TO THE ROTATION—INTERNAL TORSION LEVELS OF ECULES WITH TWO EQUIVALENT METHYL GROUPS.

Myers and E.B.Wilson, Jr.

em. Phys., Vol. 33, No. 1, 186-91 (July, 1960).

The set of coordinate transformations, corresponding to netry operations, which leave invariant the Hamiltonian ator for a molecule with two equivalent methyl groups, is ined. These constitute a group which is a direct product of two le groups, i.e., $C_{3v} \times C_{3v}$. The possible species for the energy ls, their degeneracies, their statistical weights, and the selec- rules are worked out by group theory techniques which use the properties of the smaller groups. The higher symmetry higher degeneracies given by approximate Hamiltonians are fly discussed.

539.19

5697 NOTE ON ENERGY LEVELS OF POLYATOMIC MOLECULES. S.D.Majumdar.

gr. theor. Phys., Vol. 19, No. 4, 452-3 (April, 1958).

The methods applied to the rotation of triatomic molecules, in tr. 6781 of 1954, are extended to polyatomic molecules.

J.Hawgood

539.19

15698 EXPERIMENTAL OSCILLATOR STRENGTHS OF CH AND NH. R.G.Bennett and F.W.Dalby.

hem. Phys., Vol. 32, No. 6, 1716-19 (June, 1960).

The radiative lifetimes of the $A^2\Delta$ and $B^2\Sigma$ states of CH and the state of NH have been measured to be (5.6 ± 0.6) 10^{-7}, ± 0.4) 10^{-6}, and (4.25 ± 0.6) 10^{-7} sec, respectively. The oscil- or strengths of the respective ground-state transitions were then culated to be (4.9 ± 0.5) 10^{-3}, (1.2 ± 0.4) 10^{-3}, and (8.0 ± 1.1) 10^{-3}.

539.19

15699 NOVEL CONTRIBUTION TO THE ANALYSIS OF THE ROTATIONAL STRUCTURE OF THE (1, 0) BAND OF E A($^3\Pi_i$)—X($^3\Sigma^-$) TRANSITION OF NH.

uenebaut and G.Pannetier.

. Acad. Sci. (Paris), Vol. 250, No. 22, 3613-15 (May 30, 1960).

French.

This (1, 0) band structure is deduced by study of the radiation ompanying the $HN_3 + H$ reaction.

G.I.W.Llewelyn

539.19

15700 ROTATIONAL AND VIBRATIONAL ENERGY BANDS IN SOLID HYDROGEN. J.van Kranendonk.

ysica, Vol. 25, No. 11, 1080-94 (Nov., 1959).

The coherent rotational motions of the molecules in solid hydro- n, resulting from the anisotropic intermolecular forces, are shown give rise to rotational energy bands describing travelling rota- nal excitations. The rotational energy band corresponding to J = 2 studied for quadrupolar anisotropic forces. The overall width the J = 2 energy band, and the energy levels corresponding to = 0, are calculated, taking into account the interaction between all irs of molecules. The rotational impurity problem arising in the esence of a vibrating molecule is discussed. The energies of the und v = 1, J = 2 states of a rotational excitation, resulting from the tractive interaction between the rotational excitation and the vi- ating molecule, are calculated. The theory of the vibrational ergy bands is also developed, and the vibrational impurity problem ising in the presence of an ortho molecule is discussed. The bound = 1, J = 2 level of the rotational impurity problem is shown not to affected by the coupling responsible for the vibrational energy nds.

539.19

15701 THE ROTATIONAL CONSTANTS OF HYDROGEN CHLORIDE. E.K.Plyler and E.D.Tidwell.

. Elektrochem., Vol. 64, No. 5, 717-20 (1960).

The fundamental absorption band of hydrogen chloride was easured on a high resolution spectrometer. Twenty-nine lines HCl^{35} and twenty-eight lines of HCl^{37} was measured to a high ecision by the use of the fringe system of a Fabry—Perot inter- rometer. The average deviation of the observed from the calcul- ed values is ±0.003 cm^{-1}. The rotational constants for each iso- pic species were calculated. The rotational constants have been ed to predict the position of the pure rotational spectra of HCl^{35} d HCl^{37}. The equilibrium separation of the atoms has been cal- lated to be 1.2746 A.

539.19

15702 PERTURBATION OF THE BAND OF THE FIRST HARMONIC IN THE VIBRATION-ROTATION SPECTRA OF HCl IN CONDENSED STATE. M.Atwood and Vu Hai.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3816-18 (June 8, 1960).
In French.

The perturbations of fundamental bands of HCl by solution at −70°C in He, H_2, A, N_2 and CO previously studied, have been observed for the first harmonic. In particular displacement of the Q branch appears to be comparable in the two cases, in disagreement with theory due to Buckingham which predicts doubling of the shift for the first harmonic.

R.C.Seymour

539.19

15703 SOME RESULTS OF AN INVESTIGATION OF EXCITATION FUNCTIONS OF THE BANDS IN THE NEGATIVE SYSTEM OF N_2^+. I.P.Zapesochnyi and S.M.Kishko.

Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 965-7 (1959).
In Russian.

Accurate measurements of the excitation functions of bands of the negative system, corresponding to the transition $B^2\Sigma \rightarrow X^2\Sigma$ in N_2^+, showed that (1) contrary to the published data, emission of an oxide cathode in N_2 atmosphere up to 10^{-2} mm Hg is almost the same as in vacuo, and (2) five maxima (at 29, 49, 56, 67 and a flat maximum at 85-90 eV) were observed on the excitation functions.

F.Lachman

539.19

15704 A RECENT ROTATIONAL ANALYSIS OF THE γ BANDS OF THE NO MOLECULE (INCLUDING THE UNPUBLISHED DATA OF R.SCHMID AND L.GERÖ). I.Deézsi.

Acta phys. Hungar., Vol. 9, No. 1-2, 125-50 (1958).

The rotational analysis is presented of 16 bands of the γ-band system. The constants in the electronic state $A^2\Sigma^+$ of the molecule, obtained from the analysis by extending it to relatively high rotational quantum numbers, are: $B_e = 1.9977\ cm^{-1}$, $\alpha_e = 0.0198\ cm^{-1}$, $D_e = -6.2 \times 10^{-6}\ cm^{-1}$, $\beta_e = 0.3 \times 10^{-6}\ cm^{-1}$, $r_e = 1.063 \times 10^{-8}\ cm$, $I_e = 14.0076 \times 10^{-40}\ g\ cm^2$. The constants obtained for the ground state $X^2\Pi$ are in agreement with the data of Gillette and Eyster (Abstr. 453 of 1940), within the margin of error. The dissociation energy is 6.603 eV (on the basis of the rotational analysis); this value is somewhat higher than that given recently by Herzberg et al. (Abstr. 6526 of 1956). It is thus concluded that the predissociation on the upper electronic state of the β bands does not occur above the level $\nu' = 6$ (as has been suggested by several authors), but even the level $\nu' = 7$ should exist in emission.

539.19

15705 ELECTRONIC STRUCTURE AND SPECTRUM OF ACETANILIDE. H.Baba and S.Suzuki.

J. chem Phys., Vol. 32, No. 6, 1706-13 (June, 1960).

A molecular orbital calculation has been made for the π electronic structure of acetanilide and related compounds. The simple LCAO procedure, on which the calculation is based, was somewhat modified to allow for electron repulsion. The electronic behaviours of the acetanilide molecule are examined from the viewpoint of the interaction of the phenyl and acetyl groups through the nitrogen atom. From the calculated excitation energies, oscillator strengths, and charge distributions, the features of the observed ultraviolet absorption and other electronic phenomena can be satisfactorily explained. It is shown that the changes of the longer-wavelength bands in passing from aniline to acetanilide may be interpreted in terms of two electronic effects: (1) a decrease in the tendency of the nonbonding electrons at the nitrogen atom to migrate into the benzene ring: (2) an extension of conjugation. The electronic properties in the ground state are shown to be explicable by taking account of the former effect.

539.19

15706 ELECTRONIC STATES OF p-BENZOQUINONE. V. VIBRATIONAL ANALYSIS OF THE VAPOR ABSORPTION SPECTRUM AROUND 4500 A REGION. T.Anno and A.Sadô.

J. chem. Phys., Vol. 32, No. 6, 1602-10 (June, 1960).

For previous work, see Abstr. 7274 of 1957. The absorption spectrum of p-benzoquinone vapour in the region between 4080 and 5100 A was photographed and measured. Although the theoretical calculation as well as the experimental crystal spectrum indicate that two singlet—singlet electronic transitions exist in this region, prominent vibrational structure of the vapour spectrum can be interpreted as caused by a single forbidden electronic transition. If it is assumed that the hydrogen vibrations are not effective as perturbing vibrations which make the forbidden electronic transitions allowed through the vibrational-electronic interaction, this fact suggests the following two sets of assignments for the symmetries of the forbidden transition and the perturbing allowed transition: (1) the spectrum is a superposition of ${}^1A_u$, ${}^1B_{2u} \leftarrow {}^1A_g$ transitions perturbed by a ${}^1B_{2u} \leftarrow {}^1A_g$ transition; (2) the spectrum is caused by a single ${}^1B_{1g} \leftarrow {}^1A_g$ transition being allowed through vibrational-electronic interaction with the allowed ${}^1B_{1u} \leftarrow {}^1A_g$ transition. Vibrational structure alone cannot exclude the second possibility, but a discussion supporting the first assignment is given. This assignment (1) is in agreement with the theoretical calculation of the energy levels. Most prominent bands are assigned to particular vibronic transitions. Fundamental frequencies in the excited electronic state 436, 796, 1109, and 1220 cm^{-1} are obtained corresponding probably to the ground-state values of 444, 770, 1144, and 1667 cm^{-1}

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15707 ELECTRONIC STATES OF p-BENZOQUINONE. VI. MOLECULAR GEOMETRY IN THE EXCITED ELECTRONIC STATE OF THE 4500 A ABSORPTION SYSTEM AS DERIVED FROM THE FRANCK—CONDON PRINCIPLE.

T.Anno and A.Sadô.

J. chem. Phys., Vol. 32, No. 6, 1611-19 (June, 1960).

The method used for evaluating the Condon overlap integral associated with any vibronic band of an electronic absorption system of an XY_2 molecule, as developed by Coon and his co-workers, is applied to more complex molecules. Thus, some information about the geometry of the excited electronic state of a complex molecule may be determined if the geometry in the ground state, the intensities of vibronic bands of the associated electronic absorption system, and normal coordinates and frequencies in both electronic states are known. The method is applied to the 4500 A absorption system of p-benzoquinone. Since the normal coordinate treatment for this molecule is only qualitatively valid, especially in its excited state, the results are expected to be more or less qualitative. If one takes the resulting change of bond angles into account, the ring-bending frequency of species A_u in the excited electronic state is calculated to be 438 cm^{-1} by the method described in Pt III of this series.

539.19

15708 THE INTERNAL MOBILITY OF THE CYCLOHEXANE RING. H.Kramer.

Z. Naturforsch., Vol. 15a, No. 5-6, 552-3 (May-June, 1960). In German.

Dielectric absorption at 15 and 7 mm. wavelengths was measured for several substituted cyclohexanes in benzene solutions (up to 2 mol. %). There was no indication of more than one molecular relaxation time. Comparison with similar data for analogously substituted benzenes supports rotation of the whole molecule as the relaxation process, and the view that cyclohexane derivatives have lifetimes in the respective axially or equatorially substituted configurations which are longer than the time of rotational relaxation.

J.Sheridan

539.19

15709 NOTE ON THE INTERNAL-ROTATION BARRIER IN ETHANIC COMPOUNDS. M.Karplus.

J. chem. Phys., Vol. 33, No. 1, 316-17 (July, 1960).

A theoretical treatment is outlined for estimating the contribution of deviations from perfect electron pairing to the barrier (Abstr. 6201 of 1959). A criterion of validity is obtained by estimating roughly the importance of the chief imperfectly paired structure which contributes to the barrier, by means of the measured electron—nuclear couplings from nuclear- and electron-magnetic resonance experiments. The theoretical and experimental results make it most unlikely that deviations from perfect pairing yield a major contribution to the barrier.

J.Sheridan

539.19

15710 THEORY OF ELECTRONIC EXCITATION AND REORGANIZATION IN THE FORMALDEHYDE MOLECULE.

J.M.Parks and R.G.Parr.

J. chem. Phys., Vol. 32, No. 6, 1657-81 (June, 1960).

The use of a previously described iterative method of separated electron pairs (Abstr. 9096 of 1958) is demonstrated by calculations on the formaldehyde molecule. Investigation is made, for example, of detailed changes in the polarity of sigma bonding electron wavefunctions in this molecule when a pi or lone-pair electron is excited or ionized. The molecule is treated as a six-electron problem (four electrons in the C = O bond plus two lone-pair electrons on O); matrix elements involving the "core" are obtained by fitting experimental data. The use of Pariser-type one-centre repulsion integrals is tested in conjunction with various sets of two-centre repulsion integrals. Although one combination gives reasonable results, non of the combinations is found to be entirely satisfactory, and a procedure is outlined from which could be obtained one-centre integr. approximately incorporating Arai—Hurley type corrections. It is demonstrated (with reservations) that the constant sigma structur assumption, usually made in calculations of pi electron excitations and ionizations, is not always good with regard to wave-functions, but that it may lead to only small errors in calculated energies.

539

15711 CHEMICAL EVIDENCE FOR A TRIPLET GROUND STATE FOR METHYLENE.

F.A.L.Anet, R.F.W.Bader and A.M.Van der Auwera.

J. Amer. Chem. Soc., Vol. 82, No. 12, 3217-18 (June 20, 1960).

539

15712 ELECTRONIC STRUCTURES AND SPECTRA OF NITROMETHANE AND NITROGEN DIOXIDE.

K.L.McEwen.

J. chem. Phys., Vol. 32, No.6, 1801-14 (June, 1960).

The electronic structures and spectra have been calculated b a semiempirical method. The self-consistent molecular orbitals and energies of the π-electron system have been calculated; however, for the nonbonding σ-electron system Hückel-type molecula orbitals are used. The nonbonding 2p oxygen orbitals of nitromethane are very slightly modified by mixing with the σ-electron system; in nitrogen dioxide, on the other hand, the totally symmet combination of 2p oxygen orbitals and the sp^2 nonbonding nitrogen orbital mix strongly to form slightly bonding and slightly antibond molecular orbitals. The calculated transition energies of nitrome thane are in reasonable agreement with experiment. For nitrogen dioxide a series of transition energies are obtained which may illuminate experimental results; the complexity of the empirical data, however, and the multitude of calculated low-energy excited states, preclude definite assignment of the observed band systems at this stage.

539

15713 ISOTOPIC SHIFTS OF BANDS IN THE ELECTRON-VIBRATIONAL SPECTRA OF CERTAIN DIATOMIC MOLECULES. R.R.Shvangiradze, K.A.Oganezov and B.Ya.Chikhl

Optika i Spektrosk., Vol. 8, No. 4, 452-7 (April, 1960). In Russia

The molecules studied were N_2, N_2^+, CO and CO$^+$, enriched wi N^{15} and C^{13}. The experimental results were compared with the values predicted by an elementary theory which allows for the changes of the reduced molecular mass, and the vibrational const of the isotopic molecules were determined. A graphical method i described for presentation of the isotopic shifts as a function of th vibrational quantum numbers v' and v''.

A.Tybulew

539

15714 THE EFFECT OF STRONG ILLUMINATION ON THE ABSORPTIVE POWER OF COMPLEX MOLECULES.

A.P.Ivanov.

Optika i Spektrosk., Vol. 8, No. 3, 352-8 (March, 1960). In Russi

Formulae are deduced for the absorptive power (absorptivity of systems with two and three energy levels. Conditions are discussed under which negative absorption occurs. The possibility c increase of transmission is dealt with.

A.Tybulew

539

15715 APPROXIMATE ISOTOPIC FREQUENCY RULE AND ITS APPLICATION TO THE SPECTRA OF COMPLEX MOLECULES. S.Krimm.

J. chem. Phys., Vol. 32, No. 6, 1780-3 (June, 1960).

An isotopic frequency rule is derived which is valid to a gooc approximation for individual modes of fully substituted hydrogen-containing groups in a complex molecule. It is given by $\lambda^{i}/\lambda - 1$ $(\Sigma_j \Delta T_j/\rho T)$, where $\lambda = 4\pi^2\nu^2$, $\rho = m^i/m$ = ratio of the isotopic to t normal mass, T = total kinetic energy associated with the vibrati and $\Sigma_j \Delta T_j$ = differential kinetic energy associated with the substi tuted atoms. When applied to H_2O and NH_3 this rule reproduces quency ratios to better than 0.5%. The rule is used to predict th frequency ratios for the various modes of the CH_3 group, and wit illustrations from the infrared spectra of high polymers it is sho how this rule can be of assistance in making assignments and in providing information on the separability of group vibrations.

539.19

5716 ON THE THEORY OF THE RESONANCE RAMAN EFFECT.

D.G.Rea.

olecular Spectrosc., Vol. 4, No. 6, 499-506 (1960).

An equation has been advanced by Shorygin (1952) to relate the nsity of a Raman band in the resonance region to the properties he ground and a single excited electronic level and to the uency of the exciting radiation. A prediction of this equation h, for a molecule with nondegenerate ground and excited tronic states, the depolarization ratio must be 0.50 has been fied for four substituted aromatic nitro compounds, which have ated intense absorption bands in the near ultraviolet. The ting radiation was Hg 4358 A (22 938 cm^{-1}). The stringent rictions on the equation indicate it can be applied to a very row range of systems and that it should not be used for consider- ns of a general nature such as solvent effects.

539.19

5717 EFFECTS OF SOLVENT ON RAMAN BAND INTENSITIES.

D.G.Rea.

olecular Spectrosc., Vol. 4, No. 6, 507-17 (1960).

The intensity of a Raman band of a solute is dependent on the ractive index of the solution. When instrumental effects are ored out, the intensity shows a general increase with refractive ex, the dependence being linear in many of the systems studied. the binary solutions examined there is no marked difference ween polarized and depolarized bands or between polar and non- r solvents. No explanation for this behaviour is advanced, rent theories appearing inadequate.

539.19

15718 THE ANTI-STOKES COMPONENTS OF THE RAMAN SPECTRA OF COMPOUNDS WITH HYDROGEN BONDS.

I.Ovander.

ika i Spektrosk., Vol. 8, No. 4, 477-81 (April, 1960). In Russian.

A one-dimensional model, used earlier by Stepanov (1946) and 'kenshtein et al.(1949), is used to describe the properties of a rogen bond: the model is a quantum-mechanical system consisting hree nuclei. It is shown that the structure of the anti-Stokes mponent should be similar to that of the Stokes component.

A.Tybulewicz

539.19

15719 RELATIONSHIPS BETWEEN THE INTENSITIES OF THE INFRARED BANDS OF ISOTOPIC MOLECULES.

M.Sverdlov.

ika i Spektrosk., Vol. 8, No. 2, 253-5 (Feb., 1960). In Russian.

Shows that simple relationships can be obtained between the ensities of the infrared bands of isotopic molecules and illustrates se relationships on molecules of methane, ethane, and their utero-derivatives. The relationships obtained are applicable also sums of the intensities of Raman lines.

A.Tybulewicz

539.19

15720 THE FORMULAE USED FOR CALCULATION OF INTENSITIES IN THE INFRARED MOLECULAR ECTRA.

B.N.Snegirev and M.A.Kovner.

tika i Spektrosk., Vol. 8, No. 6, 880-1 (June, 1960). In Russian.

Shows that Ferigle and Weber's formula (Abstr. 1722 of 1955) calculation of the components of the tensor of the derivatives of lecular polarizability along normal coordinates can be used for culation of the dipole-moment vector components along the same rdinate, and discusses a formula of Gribov (Abstr. 1531 of 1960) rived for the same purpose.

A.Tybulewicz

539.19

15721 CALCULATION OF THE INTENSITIES AND POLARIZATIONS IN THE INFRARED SPECTRA OF MULTIATOMIC LECULES. I.

L.A.Gribov.

tika i Spektrosk., Vol. 8, No. 6, 769-76 (June, 1960). In Russian.

Gives a method of calculation of the intensities and polarizations the infrared spectra of multiatomic molecules, based on a vector presentation of the change of the dipole moment during vibrations the given form.

A.Tybulewicz

539.19

15722 NEAR-INFRARED ABSORPTION SPECTRA OF ORTHO- AND PARA-H_2O IN SOLID XENON AND ARGON.

A.Glasel.

chem. Phys., Vol. 33, No. 1, 252-5 (July, 1960).

The near-infrared absorption spectra of H_2O trapped in solid A and Xe was studied at 20°K. The spectra, taken at concentrations of H_2O to matrix of 1 : 600, exhibit structure which is analysed in terms of the known rotational and vibrational constants of the H_2O molecule. The results show that in solid xenon and argon matrices, the monomer H_2O exists as two modifications, one of which is rotating in its ground vibrational state. The theoretical intensities for the spectral bands of H_2O gas at 20°K are calculated and shown to agree with the bands observed in H_2O—Xe. The changes in the observed intensities for other matrices are discussed. The changes in the spectra of the films when they are warmed to 35°K are shown and discussed.

539.19

15723 SEARCH FOR A JAHN—TELLER EFFECT IN IrF_6.

H.H.Claassen and B.Weinstock.

J. chem. Phys., Vol. 33, No. 2, 436-7 (Aug., 1960).

An investigation of the vibrational spectra of IrF_6 has failed to reveal the anomalies found for OsF_6 that were attributed to a Jahn—Teller coupling. This is taken to indicate that the Γ_8 ground electronic state of IrF_6 has a strong spin character. For the vapour in the NaCl range the observed absorption frequencies (cm^{-1}) and their assignments were: 720 (σ_3), 852 ($\sigma_2 + \sigma_6$), 921 ($\sigma_2 + \sigma_4$), 979 ($\sigma_1 + \sigma_4$), 1364 ($\sigma_2 + \sigma_3$), and 1425 ($\sigma_1 + \sigma_3$). A Raman shift of 651 cm^{-1} ascribed to σ_2 was obtained for a solution of IrF_6 in n-C_7F_{16}.

539.19

15724 STRUCTURE OF THE INFRARED Y BANDS OF N_2.

G.H.Dieke and D.F.Heath.

J. chem Phys., Vol. 33, No. 2, 432-6 (Aug., 1960).

The rotational analysis of the n + 4, 3 band of the "Y" system of N_2 shows that the initial state is a $^3\Sigma_u^-$ level with $B_{n+4} = 1.3325$. The band has exactly the structure to be expected from a $^3\Sigma_u^- \rightarrow {}^3\Pi_g$ transition and all expected 27 branches have been observed. The triplet separation of the $^3\Sigma$ state degenerates into a doublet for all but the lowest values of K as the two states with J = K ± 1 nearly coincide.

539.19

15725 PHOTOELECTRIC DETERMINATION OF THE EXCITATION FUNCTIONS OF THE NEGATIVE-BAND SYSTEM OF N_2^+.

S.M.Kishko.

Optika i Spektrosk., Vol. 8, No. 2, 160-4 (Feb., 1960). In Russian.

Describes a determination of the electron-beam excitation functions (dependences of the band intensity on the electron energy) of the negative band system of N_2^+, emitted in the transition $B^2\Sigma \rightarrow X^2\Sigma$. The relative excitation functions of the (0 → 0) and (0 → 1) bands, whose edges were at 3914 and 4278 A respectively, had five maxima at electron energies of 29, 49, 56, 67 and 85-90 eV at a nitrogen pressure of 1μ Hg. On gradual increase of the nitrogen pressure these maxima disappeared; they disappeared also when the spread of the kinetic energies of the incident electrons increased beyond 1-2 eV.

A Tybulewicz

539.19

15726 PERTURBATION OF MOLECULAR ROTATION—VIBRATION ENERGY LEVELS BY RARE GASES.

D.H.Rank, D.P.Eastman, W.B.Birtley and T.A.Wiggins.

J. chem. Phys., Vol. 33, No. 2, 323-6 (Aug., 1960).

The shift in frequency of lines of the 2-0 band of HCl and of the $v_1 + v_3$ band of C_2H_2 due to the presence of krypton and xenon as foreign gases was measured. A marked J dependence was observed. The relative shifts in the upper and lower states of the transitions were calculated from the shifts in the Δ_2F'' (J) and Δ_2F' (J) values obtained from the measured line shifts. In the case of HCl the shifts in the rotational levels were markedly different in the upper and lower states, the upper state shift being proportional to J, while the lower-state energy-level shifts approach an asymptotic value for high J. For C_2H_2 the shifts in both levels resembled the shift in the lower state of HCl.

539.19

15727 SHAPES AND BREADTH OF SOME MOLECULAR ROTATION—VIBRATION BAND LINES PERTURBED BY RARE GASES.

D.H.Rank, D.P.Eastman, W.B.Birtley and T.A.Wiggins.

J. chem. Phys., Vol. 33, No. 2, 327-8 (Aug., 1960).

The shape of absorption lines of HCl and C_2H_2 broadened with krypton and xenon as foreign gases is shown to be that due to collision broadening. Corrections for instrumental width are made in the manner described by Pigott and Rank to determine the half-intensity width. These widths show a small J dependence with low-J lines being the broadest. No difference between the widths of P and R lines of the same J could be detected. For high J's the quotient of the shift of the line and the width of the line is approximately constant for krypton and xenon. The breadth of HCl and C_2H_2 lines are not markedly different in spite of the difference in dipole moment. No asymmetry of lines perturbed by these foreign gases was observed.

539.19 : 534.22

15728 LUMINOSITY OF SHOCK WAVES IN XENON.

J.N.Bradley.

J. chem. Phys., Vol. 32, No. 6, 1875-6 (June, 1960).

The mechanism suggested earlier by Roth and Gloersen (Abstr. 1269 of 1959) is criticised mainly because it predicts a time dependence of excited Xe molecule concentration not in agreement with experiment. It is suggested that, on the basis of new data (Abstr. 13152 of 1959), a suitable mechanism would be the formation of Xe molecules in a higher excited state, dissociation into an unexcited atom and an atom in a metastable state, with emission of visible radiation. This explains why ultraviolet emission from the metastable atoms continues to increase until the visible radiation disappears. See also following abstract. P.Gray

539.19 : 534.22

15729 REPLY TO "LUMINOSITY OF SHOCK WAVES IN XENON". W.Roth.

J. chem. Phys., Vol. 32, No. 6, 1876 (June, 1960).

It is conceded that the mechanism proposed by the present author and Gloerson (Abstr. 1269 of 1959) does not explain successfully the observed approach to steady-state emission. The suggestion (see preceding abstract) that a higher excited state of the Xe molecule comes into play is not so far borne out by experimental evidence. P.Gray

539.19

15730 EMISSION SPECTRUM OF THE OH RADICAL IN AN OXYACETYLENE FLAME IN THE 1.5-μ REGION.

W.H.Rogge, F.I.Yarger and F.P.Dickey.

J. chem. Phys., Vol. 33, No. 2, 453-5 (Aug., 1960).

In these observations, the strong background which results from H_2O emission in the same flame was eliminated by a double-beam method using two flame sources. The spectrum of the 2-0, 3-1, and 4-2 vibration—rotation bands of OH are shown.

539.19

15731 INFRARED BAND SHAPES AND THE ROTATIONAL FREEDOM OF METHYL BROMIDE ADSORBED ON POROUS GLASS. M.V.Mathieu, N.Sheppard and D.J.C.Yates.

Z. Elektrochem., Vol. 64, No. 5, 734-7 (1960).

A study has been made of the parallel and perpendicular infrared absorption bands ν_1 and ν_4 of methyl bromide physically adsorbed on porous glass at a surface coverage of about 0.5, and at the temperatures of 293 and ~78° K. The sharpness of the ν_1 band at room temperature as compared with the same band in the gas phase shows that free rotation about axes perpendicular to the 3-fold molecular axis does not occur in the adsorbed state; this is probably because of hydrogen bonding between surface OH groups and the bromine atoms. However, in the adsorbed state at room temperature ν_4 retains much of the width of the gas-phase band, and on cooling to low temperatures it becomes markedly narrower, approximately to the extent expected if rotation about the 3-fold molecular axis remains essentially free. The behaviour at low temperature is inconsistent with a hypothesis which would explain the room-temperature bandwidth as being caused by partial splitting of the vibrational degeneracy.

539.19

15732 INFRARED SPECTRA OF ALKYLDIBORANES. II. MONOETHYLDIBORANES.

W.J.Lehmann, C.O.Wilson, Jr and I.Shapiro.

J. chem. Phys., Vol. 32, No. 6, 1786-90 (June, 1960).

For Pt I, see Abstr. 7760 of 1960. The infrared spectra of five isotopic variants of monoethyldiborane, $C_2H_5B_2{}^{10}H_5$, $C_2H_5B_2H_5$, $C_2H_5B_2D_5$, $C_2D_5B_2H_5$, and $C_2D_5B_2D_5$, are analysed and frequency assignments are made. The frequencies and intensities of the various bands are compared with those in the corresponding monomethyldiboranes and the related terminally substituted B_2H_5D and B_2D_5H, as well as with triethylboranes. In addition, vapour-pressure data in the -58° to -110°C range for isotopically normal ethyldiborane are reported.

539.19 : 532.7 : 535.

15733 COMPARISON OF THE EFFECTS OF HIGH PRESSUR AND LOW TEMPERATURE ON THE ABSORPTION SPECTRA OF SOME CONDENSED-RING AROMATICS.

W.W.Robertson.

J. chem. Phys., Vol. 33, No. 2, 362-5 (Aug., 1960).

A comparison of the spectral shifts obtained by lowering the temperature of a solution to those obtained by increasing its hydro static pressure shows that the temperature shift is composed of tw oppositely directed components. The larger one is the red shift du to solvent density increase with temperature decrease and the accompanying increase in dispersion forces. The second and usua smaller effect is a blue shift that results from a change in the sha of the band as a result of a decrease in the population of the higher vibrational levels with a decrease in temperature.

539.

15734 SPECTRUM OF CYCLOOCTATETRAENYL RADICAL ANION. T.J.Katz and H.L.Strauss.

J. chem. Phys., Vol. 32, No. 6, 1873-4 (June, 1960).

The spectrum comprises nine equally spaced lines in the intensity ratios expected for hyperfine interaction with eight equivalent protons. The separation of the lines was 3.209 ± 0.007 and they were centred on g = 2.0025 ± 0.0001. The cyclooctatetraenyl radical anion (in solutions) is one of the few systems where t unpaired electron spin density on the carbon atoms can be inferre from symmetry considerations alone, so that the hyperfine structu parameters are susceptible to a more detailed theoretical analysis that would be possible if the electron spin densities were unknown. J.M.Bak

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15735 INFRARED ABSORPTION SPECTRUM OF METHANE FROM 2470 TO 3200 cm^{-1}.

E.K.Plyler, E.D.Tidwell and L.R.Blaine.

J. Res. Nat. Bur. Stand., Vol. 64A, No. 3, 201-12 (May-June, 1960).

The absorption spectrum of methane has been measured from 2470 to 3200 cm^{-1} with a high-resolution infrared spectrometer. Pressures from 0.01 to 4.5 cm of the gas were used in order to observe both intense and weak lines. A total of 2460 lines were measured in the entire region. The ν_3 band at 3018 cm^{-1} was measured at very slow scanning rates and the lines of the P and R branches were resolved into several components. The observed spectrum is shown in five figures.

539.1

15736 ULTRAVIOLET ABSORPTION SPECTRA OF THE MOLECULES H_2O, HDO AND D_2O.

J.Barrett and A.L.Mansell; R.M.Golding.

Nature (London), Vol. 187, 138, 139 (July 9, 1960).

Spectra recorded at 25° C and 50° C are presented and discuss The marked dependence on temperature is attributed to varying degrees of hydrogen bonding. In an addendum, the effect on the u. spectrum of water of flushing the optical system with oxygen-free nitrogen during measurements is discussed. G.I.W.Llewely

539.

15737 MICROWAVE SPECTRUM OF $CFCl_3$.

M.W.Long, Q.Williams and T.L.Weatherly.

J. chem. Phys., Vol. 33, No. 2, 508-16 (Aug., 1960).

The hyperfine spectrum of the J = 1 → 2 transition is calculat for symmetric-top molecules having three identical nuclei of spin Measurements on the J = 1 → 2 through J = 6 → 7 transitions of $CFCl_3$ are described and the results are used to determine the molecular structure, the quadrupole coupling constant with respec to the molecular symmetry axis, and the centrifugal distortion coefficients. The J = 1 → 2 transition of $CHCl_3$ was measured and the results are compared with those for $CFCl_3$ and with previous work on $CHCl_3$

539.

15738 MICROWAVE SPECTRUM, STRUCTURE, AND DIPOL MOMENT OF FORMYL FLUORIDE.

O.H.LeBlanc, Jr, V.W.Laurie and W.D.Gwinn.

J. chem. Phys., Vol. 33, No. 2, 598-600 (Aug., 1960).

The microwave spectra of several isotopic species of formyl fluoride were investigated in the region 11-46 kMc/s. Both parall and perpendicular transitions were assigned. The effective rotati al constants for $HC^{12}OF$ are (Mc/s): a = 91153.6, b = 11760.0, c = 10396.8; for $HC^{13}OF$, a = 88475.3, b = 11755.2, c = 10357.3; fo $DC^{12}OF$, a = 65090.1, b = 11761.7, c = 9941.7. From these constan

tructural parameters are calculated to be $r_{CF} = 1.34_1$ A,
$= 1.18_3$ A, $r_{CH} = 1.10_0$ A, $\sphericalangle$ FCO = 122.7°, $\sphericalangle$ HCF ≅ 108°,
CO ≅ 129°. Measurements of the Stark effect lead to a value
02 ± 0.02 debyes for the dipole moment.

539.19 : 532.7

5739 THE EFFECT OF SOLVENTS ON THE ELECTRONIC SPECTRA OF ORGANIC MOLECULES.

I.A.Zhmÿreva,
Zelinskii, V.P.Kolobkov, A.S.Kochemirovskii and I.I.Reznikova.
ka i Spektrosk., Vol. 8, No. 3, 412-14 (March, 1960). In Russian.
Uses empirical data and theoretical reasoning to criticise
shiev's relations (1959) between the effect of solvents on the
tronic spectra of organic compounds and the refractive indices
permittivities of the solvents. A.Tybulewicz

539.19

5740 ON THE ELECTRONIC SPECTRUM OF FORMYL FLUORIDE.

A.Foffani, I.Zanon, G.Giacometti,
lazzucato, G.Favaro and G.Semerano.
vo Cimento, Vol. 16, No. 5, 861-6 (June 1, 1960).
The vapour spectrum of formyl fluoride in the range
)0 — 2700) A shows about 60 non-diffuse bands. Comparison with
solution spectrum and the temperature effect allows one to iso-
two main progressions of the excited state, with a pass of about
0 and 640 cm^{-1}, assigned respectively to the carbonyl stretching
to the FCO deformation modes. The transition is probably of
singlet—singlet n—π type, with the origin at 37500 cm^{-1}.

539.19

15741 COEFFICIENT OF CONTINUOUS ABSORPTION OF RADIATION BY QUASI-MOLECULES OF HYDROGEN.

.Erkovich.
ika i Spektrosk., Vol. 8, No. 3, 307-11 (March, 1960). In Russian.
The absorption coefficient of quasi-molecules of hydrogen in
$^3\Sigma_g^+$ state was calculated as a function of temperature and hydro-
-atom concentration. It was found that this quasi-molecular ab-
ption is important in a wide range of temperatures and pressures.
A.Tybulewicz

539.19 : 532.7 : 535.33

15742 SOLVENT EFFECTS ON n → π* TRANSITIONS IN PYRAZINE.

V.G.Krishna and L.Goodman.
chem. Phys., Vol. 33, No. 2, 381-6 (Aug., 1960).
The T → S and S → S' spectra of pyrazine and 2,5-dimethyl-
razine in hydrocarbon and EPA glasses were measured. The
S' and S →T spectra of the same compounds in ethanol and
pentane are also reported. When due correction is made for the
ect of the rigid media, solvent shifts (from hydrocarbon to EPA)
60^{-1} to the red in emission and the same amount to the blue in
sorption are obtained for the 0—0 band. The absorption maximum
shifted by approximately 1200 cm^{-1} to the blue and the emission
ximum by about 600 cm^{-1} to the red. The data is explained in
ms of the weak hydrogen bonding and the Franck—Condon strain
sulting therefrom. It is suggested that due to the change in the
tension of the n orbitals in nitrogen atoms of N heterocyclics, a
anck—Condon destabilization energy results in protonic solvents.
e role of the Franck—Condon principle in the n → π* blue shift
enomenon is found to be of considerable importance in accordance
th Pimentel's views. The previously reported discrepancy of
0 cm^{-1} in the 0—0 bands of the T → S emission and S → T absorption
these compounds is entirely explained by media effects.

539.19

15743 CALCULATION OF DELOCALIZATION CONTRIBUTION TO INFRARED INTENSITY.

.D.Jones and W.T.Simpson.
chem. Phys., Vol. 32, No. 6, 1747-56 (June, 1960).
Infrared intensity may be related to energies and intensities
electronic transitions by using the theory of the vibrational
rturbation of electronic transitions and holding the electronic
ate quantum number fixed. This suggests in particular relating
e infrared intensity of an appropriate normal mode to the strong
traviolet absorption in dye-like molecules having conjugated
-electron systems. The perturbation theory is tested by applying
to a displaced hydrogen atom and the hydrogen molecule ion.
he results suggest the need for modifying the theory to employ
oating orbitals. A floating orbital theory of infrared intensity
hich still brings in ultraviolet transition energies and moments
then constructed. This theory is next applied to the model
mpounds H_3^+, H_5^+ and H_7^+ and there is predicted an extraordinarily
high delocalization contribution to the intensity for the anti-symmetric stretch. Values for the dipole derivatives are calculated ranging up to 65 debyes/A.

539.19

15744 NUCLEAR CHARGE EFFECT ON THE FREE-ELECTRON MODEL ENERGY STATES.

S.Olszewski.
Acta phys. Polon., Vol. 18, No. 2, 107-20 (1959).

The scheme presented permits the calculation of the influence which the positive centres distributed along a potential box of the linear free-electron model have on the energy states of this model. The numerical calculations included the configurational interaction for the two and four-centres problems (ethylene and butadiene in the π-electron approximation). The computations were done by assuming an equidistant distribution of the centres in the model and that the box radius tends to zero. The results obtained for the case of the lowest excited singulet states are in surprising agreement with the corresponding states calculated by means of the LCAO MO model. At the same time it was found necessary to assume a very strong screening of the nuclei. This may be considered as a consequence of the geometry of the problem. The scheme was applied also to calculation of the positions of the absorption maxima corresponding to the lowest electron transitions in Simpson symmetrical cyanine dyes. The results remain in especially good agreement with experiment if it is assumed that the nitrogen atom localizes the free-electron pair. It is pointed out that if one includes the effect of the interaction of nuclear charges on the electrons of the model, it is found that the energy states group themselves in zones analogous to the energy zones known from the band theory of solids.

539.19

15745 ON THE COULOMB AND EXCHANGE OPERATORS IN THE FREE-ELECTRON MODEL.

S.Olszewski.
Acta phys. Polon., Vol. 18, No. 2, 121-32 (1959).

The Coulomb and exchange operators occurring in the Hartree—Fock equations for molecular orbitals of the linear free-electron model are given for the case of a potential box radius tending to zero in the form of explicit and finite functions of the position of the electron on which the operators actually act. The Hartree—Fock differential-integral equations are then replaced by ordinary differential equations. This has been done with the reservations that the Coulomb and exchange operators were calculated by assuming a suitably modified expression for the mutual interaction between electrons and an exchange potential of the Slater-type averaged over the entire region of the potential box was introduced as the exchange operator. The calculation gave expressions reproducing the energies of the respective states, whereby the approximations introduced are taken into account, plus quantities that are the same for all states. The form proposed for the Coulomb and exchange operators is that obtained from the above calculations, where those parts contributing to the reproduction of the above-mentioned uniform quantities which exceed the energies of the calculated states, or which gave a value of zero, are discarded.

539.19

15746 INTENSITIES IN $\Sigma-\Delta$ AND $\Pi-\Delta$ TRANSITIONS OF DIATOMIC MOLECULES.

I.Kovács.
Canad. J. Phys., Vol. 38, No. 7, 955-63 (July, 1960).

Explicit expressions are obtained for the intensity distribution in the branches of $^1\Sigma-^3\Delta$, $^3\Sigma-^3\Delta$, and $^1\Pi-^3\Delta$ bands. They are valid with satisfactory accuracy for any value of the coupling constant of the $^3\Delta$ state.

539.19

15747 "FORBIDDEN" CHARACTER IN ALLOWED ELECTRONIC TRANSITIONS.

A.C.Albrecht.
J. chem. Phys., Vol. 33, No. 1, 156-69 (July, 1960).

A theory for calculating the intensity of "forbidden" character in allowed electronic transitions is given based upon the early work of Herzberg and Teller (1933). It is seen how both symmetric and non-totally symmetric vibrations may be active in the perturbation, and the temperature dependence of "forbidden" intensity is explicitly obtained for harmonic oscillator wave-functions. As an example the case of certain p-disubstituted benzenes is discussed in detail. A model derivative normal coordinate analysis is used to calculate perturbation energies in terms of electronic wave-function parameters. It is seen how the magnitude of "forbidden" character is very sensitive to the detailed nature of the mixing electronic wave-functions. Several trial functions are introduced to calculate the ratio of "forbidden" to allowed character in the near ultraviolet band. Comparison is made with recent observations of mixed polarization in two benzene derivatives. Finally, the possible significance of "forbidden" character with respect to radiationless transitions is briefly discussed.

539.19

15748 VIBRONIC CALCULATIONS IN BENZENE.

A.C.Albrecht.

J. chem. Phys., Vol. 33, No. 1, 169-78 (July, 1960).

A group-theoretical reduction incorporating normal-coordinate parameters is applied to obtain expressions for the oscillator strengths of forbidden B_{2u}, B_{1u}, and E_{2g} transitions in benzene in terms of the minimum number of electronic integrals. The simplification obtained encourages the testing of wave-functions within the Herzberg—Teller framework as well as empirical evaluation of the theory. An investigation is made of the possible effect of isotopic substitution on forbidden intensities. The group-theoretical reduction is carried out for 1,4 dideuterobenzene, sym-benzene-d_3, 2,3,5,6-tetradeuterobenzene, benzene-d_6, and a hypothetical molecule p-di-X-benzene (where (X) = 20 and C – X = 1.40 A). It is observed that the B_{2u} and B_{1u} transitions are very insensitive to mass effects independent of the nature of the electronic functions. On the other hand, E_{2g} transitions may or may not show a significant sensitivity depending on the details of the wave-functions. By way of illustration, oscillator strengths are calculated for all compounds for B_{2u}, B_{1u}, and two E_{2g} transitions using conventional benzene ASMO functions and published integrals. The distribution of oscillator strengths among all active normal modes is given for benzene, benzene-d_6, and p-di-X-benzene. It is found that especially for the E_{2g} transitions the distribution among normal modes is considerably more sensitive to mass effects than is the total oscillator strength. A general expression is given for the temperature dependence of "forbidden" transition probabilities.

539.19

15749 AN APPROXIMATE METHOD OF CALCULATION OF THE FRANCK—CONDON FACTORS.

L.M.Biberman and I.T.Yakubov.

Optika i Spektrosk., Vol. 8, No. 3, 294-9 (March, 1960). In Russian.

Describes approximate method of calculation of the Franck—Condon factors of diatomic molecules, applicable in the case of large vibrational quantum numbers. A.Tybulewicz

539.19

15750 INTENSITY MEASUREMENTS ON THE CO$^+$ COMET TAIL, AND THE BO α AND β MOLECULAR BAND SYSTEMS.

D.Robinson and R.W.Nicholls.

Proc. Phys. Soc., Vol. 75, Pt 6, 817-25 (June, 1960).

Relative band intensities of the comet tail system ($A^2\Pi - X^2\Sigma$) of CO$^+$ and of the $\alpha(A^2\Pi - X^2\Sigma)$ and $\beta(B^2\Sigma - X^2\Sigma)$ systems of BO were measured photoelectrically. They were interpreted with the aid of Franck—Condon factors $q_{v'v''}$ and r-centroids $\bar{r}_{v'v''}$ to show the variation of electronic transition moment $R_e(r)$ with internuclear separation r and thereby to give "smoothed" arrays of relative vibrational transition probabilities $p_{v'v''}$ and intensities at infinite temperature I_∞. The isotope effect on the Franch—Condon factors and intensities in the case of $B^{10}O$ and $B^{11}O$ band systems were examined.

539.19

15751 GAUSSIAN WAVE FUNCTIONS FOR THE HYDROGEN MOLECULE.

J.V.L.Longstaff and K.Singer.

Nature (London), Vol. 186, 799-800 (June 4, 1960).

Results are given of a many-parameter variational calculation for the binding energy of H_2, using Gaussian wave-functions including correlation terms. With 71 variational parameters the binding energy obtained was 4.58 eV, which was reduced to 4.35 eV if the correlation terms were removed. J.Hawgood

539.19

15752 SEMIEMPIRICAL CALCULATION OF THE LOW ELECTRONIC ENERGY LEVELS OF THE HFCO MOLECULE.

G.Giacometti, G.Rigatti and G.Semerano.

Nuovo Cimento, Vol. 16, No. 5, 939-49 (June 1, 1960). In Italian.

The low energy levels of the n and π electrons for the HFCO molecule are calculated by the LCAO, MO, SCF method in the semi-empirical version given by Pople—Pariser—Parr. The predicted frequency of the $n \rightarrow \pi$ transition is discussed and compared with a recent experimental value and with the value of the analogous formaldehyde transition.

539.

15753 THE TRANSITION PROBABILITY IN THE γ- AND β-SYSTEMS OF NO BANDS.

S.P.Erkovich and Yu.V.Pisarevskii.

Optika i Spektrosk., Vol. 8, No. 3, 303-6 (March, 1960). In Russia

The electron transition moments $R_e(r)$ were calculated for th γ- and β-systems of NO bands (the $A^2\Sigma - X^2\Pi$ and $B^2\Pi - X^2\Pi$ transition) using the experimental data on the absorption spectra reported by Marmo (Abstr. 3311 of 1954) and Mayence (Abstr. 740 o 1953). A.Tybulewi

539.

15754 RADIATIVE LIFETIME OF THE $B^2\Sigma^+$ STATE IN N_2O^+

I.E.Dayton, F.W.Dalby and R.G.Bennett.

J. chem. Phys., Vol. 33, No. 1, 179-81 (July, 1960).

The radiative mean lifetime of the upper electronic state ($B^2\Sigma^+$) giving rise to the 3541 A band of N_2O^+ was measured to be $\tau = (2.6 \pm 0.2) \times 10^{-7}$ sec, which corresponds to an oscillator stre $f = (3.65 \pm 0.28) \times 10^{-3}$. Information about the emission spectrum N_2O^+ is also presented.

539

15755 POLARIZATION OF THE FIRST TWO ELECTRONIC TRANSITIONS OF PYRENE.

R.M.Hochstrasser.

J. chem. Phys., Vol. 33, No. 2, 459-63 (Aug., 1960).

The polarization of the first two electronic transitions in the pyrene molecule was determined by measuring the absorption spe in polarized light of oriented single crystals containing pyrene. T lowest molecular level (3700 A) is assigned as $^1B_{3u}$ on the basis o the polarized absorption spectrum at room temperature of pyrene in phenanthrene. The second (3500 A) molecular level is assigned as $^1B_{3u}$ from the polarized spectrum of pyrene is dibenzyl. Altho this result agrees with previous experimental evidence the assignments are at variance with theoretical predictions and thus sugges that a new model is necessary to predict the molecular levels of pericondensed hydrocarbons.

539.

15756 ANOMALOUS RELAXATION OF HYPERFINE COMPONENTS IN ELECTRON SPIN RESONANCE.

J.W.H.Schreurs, G.E.Blomgren and G.K.Fraenkel.

J. chem. Phys., Vol. 32, No. 6, 1861-9 (June, 1960).

It is shown that the different hyperfine components in the elec ron resonance spectra of free radicals exhibiting proton hyperfine splitting saturate at different rates, and different sets of relaxatio times must be used to describe the behaviour of each component. The variations in the relaxation times (T_1 and T_2) were found to b approximately symmetric about the centre of the spectrum, and th central component is the narrowest and saturates more readily th the outer components. A qualitative discussion is given of the relaxation and line-broadening mechanisms which may be responsibl for the variations in T_1 and T_2. In solutions of the p-benzosemiquinone ion at room temperature, the values of T_1 and T_2 were fou to be approximately 10^{-6} sec. An analysis is given of the experim tal parameters which affect saturation measurements, including th effect of a nonuniform r.f. field in a rectangular cavity, and a stud is made of the type of spectra to be expected when the individual hyperfine components have different values of T_1 and T_2. An appe dix is included on the work of Jen et al. on deuterium atoms trapp at liquid helium temperature, which shows that the anomalous inte sities obtained in these low-temperature experiments as a functio of r.f. power is not the same as the phenomenon observed for free radicals in solution and cannot be adequately interpreted in terms of any currently proposed mechanisms.

539.

15757 NUCLEAR MAGNETIC SHIELDING IN MOLECULES: HYDROGEN MOLECULE.

S.K.Sinha and A.Mukherji.

J. chem. Phys., Vol. 32, No. 6, 1652-6 (June, 1960).

A method for calculating the nuclear magnetic shielding in mo cules has been developed using valence-bond or LCAO type molecular orbitals. The perturbation of the molecular wave-function d to a steady magnetic field is derived by solving the first-order pe turbation equation. The method has been applied to the calculation of proton shielding in the hydrogen molecule with the Wang function. value of $\sigma^p = -0.55 \times 10^{-5}$ is in good agreement with the value of -0.56×10^{-5} derived by Ramsay from the experimental value of th spin-rotational coupling constant in the hydrogen molecule.

539.19

758 CALCULATIONS OF THE NUCLEAR QUADRUPOLE COUPLING CONSTANT FOR I_2. D.V.G.L.Narasimha Rao.

n J. Phys., Vol. 33, No. 3, 103-6 (March, 1959).

escribes theoretical studies on the quadrupole coupling constant in the I_2 molecule using the general principles of Townes and y (1949). The I—I bond is assumed to be of a covalent type. ts of sp-hybridization are considered and the results indicate ossibility of considerable amount of hybridization of the bonding als.

539.19

759 ANALYSIS OF THE NUCLEAR MAGNETIC RESONANCE SPECTRUM OF A SIX-SPIN SYSTEM OF MONOFLUORO- ZENE. S.Fujiwara and H.Shimizu.

hem. Phys., Vol. 32, No. 6, 1636-42 (June, 1960).

Deals with the general analysis of a six-spin system belonging e point group C_{2v}, using monofluorobenzene as an example. apparatus used for the n.m.r. measurements operated at 30 Mc/s. The absorption lines calculated suggest the doublet cture of the spectrum, which is consistent with the observed trum. It was confirmed that this doublet structure is due to the —spin couplings of the ring protons with fluorine. More pre- comparison of the calculated results with the observed spectrum made by integrating the intensities of the lines having a suitable shape and width. It was noted that this procedure for construc- the absorption spectrum from the calculated lines is useful in discussion of the power of resolution of the apparatus and the of line shape.

539.19

5760 RELATIVE SIGNS OF SPIN—SPIN INTERACTIONS IN NUCLEAR MAGNETIC RESONANCE. II. S.Alexander.

hem. Phys., Vol. 32, No. 6, 1700-5 (June, 1960).

For Pt I, see Abstr. 8389 of 1958. The spectrum of the allyl up in allyl amine is discussed in detail. The interpretation of spectra of 1-butene and 3,3-dimethyl-1-butene are also discussed. shown how the chemical shifts, spin—spin interactions, and in icular the relative signs of the latter can be determined by erical methods. In all three molecules all spin—spin interactions ng the vinyl protons have the same sign. One of the three vinyl- hylene interactions is found to have a different sign than the r two. This interaction has the same sign (and approximately same magnitude) as the methyl-methylene interaction in 1-butene.

539.19

15761 INDUCTION STUDIES IN SEVERAL GROUPS OF HALOGEN-CONTAINING ORGANIC COMPOUNDS BY EIR Cl^{35}, Br^{79}, OR Br^{81} PURE QUADRUPOLE RESONANCE ECTRA. H.O.Hooper and P.J.Bray.

hem. Phys., Vol. 33, No. 2, 334-61 (Aug., 1960).

Induction studies were carried out in several groups of halogen- taining organic compounds by means of the halogen pure quad- ole spectra. In several straight-chain compounds inductive effects e examined as a function of the length of the chain in some mono- ogenated-paraffin hydrocarbons and as a function of the number carbon atoms separating halogen atoms attached to either end of alogenated-paraffin hydrocarbons. The effects of the hybridization he carbon atom was also examined in some aliphatic hydrocarbons. orine pure quadrupole resonance frequencies from chlorine atoms ded to atoms other than carbon, such as silicon, nitrogen, and phur, were measured, and the effects of these different atoms upon Cl^{35} resonance frequencies are qualitatively discussed. Induc- e effects were also examined in different groups of aromatic npounds. The inductive effect in several chlorobenzyl compounds found to be about $\frac{3}{4}$ of what it is in the corresponding chlorobenzene npounds as determined from a comparison of the Cl^{35} frequencies. finite discrepancies were observed between the Cl^{35} spectra ained from several aromatic compounds which have molecular uctures similar to anthraquinone and the Cl^{35} frequencies that be predicted from data obtained from chlorobenzene compounds Hammett σ values. Employing the linear relationship between ^{35} resonance frequency and Hammett σ values, several Cl^{35} frequ- cies were predicted and compared to the measured frequencies some chlorobenzene compounds. Some unknown σ values have so been predicted. A linear relationship between Br^{81} resonance quencies and Hammett σ values was developed from measured omine quadrupole frequencies. Several halogen frequencies from me unrelated compounds were measured and are tabulated.

539.19

15762 LIGAND SPIN DENSITIES AND MAGNETIC PROPERTIES OF SOME AMINOTROPONEIMINE CHELATES OF NICKEL. W.D.Phillips and R.E.Benson.

J. chem. Phys., Vol. 33, No. 2, 607-8 (Aug., 1960).

Large proton resonance shifts and spin—spin structure were observed in nickel N, N^1-diphenylaminotroponeimineate and in the diethyl compound. The temperature-dependent shifts are interpreted in terms of a contact interaction of protons with electronic spin in a singlet ground state and an accessible triplet state. The meaning of the deduced spin densities is discussed. J.G.Powles

539.19

15763 THE EFFECT OF MOLECULAR INTERACTIONS ON N.M.R. REFERENCE COMPOUNDS. E.D.Becker.

J. phys. Chem., Vol. 63, No. 9, 1379-81 (Sept., 1959).

A study has been made of the effect of molecular interactions on the proton magnetic resonance (p.m.r.) frequencies of cyclohexane and tetramethylsilane, two compounds that are frequently used as internal references for p.m.r. investigations. In most of the cases studied the resonance frequencies of these compounds shifted 1-4 c/s (at 40 Mc/s) when the composition of solutions containing the compounds was varied over a wide concentration range. The presence of hydrogen bonding molecules did not cause appreciably larger interaction effects than were found for hydrocarbon—CCl_4 solutions, but benzene at high concentration caused interaction shifts of 15-17 c/s.

539.19

15764 SOME STUDIES IN MOLECULAR ORBITAL THEORY. I. Y.I'Haya.

J. Amer. Chem. Soc., Vol. 81, No. 23, 6120-7 (Dec. 5, 1959).

A simple interaction theory based on the single confuration LCAO MO method is applied to the problem of the ionization potentials and the near ultraviolet absorption spectra of mono-substituted benzenes with special reference to the evaluation of the empirical parameters. Both conjugative and inductive effects are included. To estimate parameters, only interactions between the highest occupied and the lowest vacant molecular orbitals of benzene and the occupied π-orbital of the substituent are considered, but the theory predicts the perturbed orbital energies with reasonable accuracy. General principles for parameter determination are given and three separate methods are applied to halogen monosubstituted benzenes. Parameters obtained in the three ways are found to reproduce the observed spectroscopic data quite satisfactorily. Extensive further applications of the theory are shown to be possible.

539.19

15765 SOME STUDIES IN MOLECULAR ORBITAL THEORY. II. Y.I'Haya.

J. Amer. Chem. Soc., Vol. 81, No. 23, 6127-34 (Dec. 5, 1959).

Conjugative and inductive effects in substituted benzenes are scrutinized by means of a second-order perturbation method based on molecular orbital theory including electron interaction but neglecting overlap. It is found that a mixing of the one- and two-electron excited states of benzene and the so-called electron transfer states which arise from the transfer of an electron from the substituent to benzene play an important role in determining the energies of the lower electronic states of substituted benzene. The conjugative and inductive parameters are determined for chlorobenzene, bromobenzene and phenol using the observed ionization potentials and the spectral shifts of the lowest L_b bands in these molecules. The agreement between the computed and observed energies of the lower electronic states in these molecules is satisfactory for the L_a band, not so good for the B_b band.

539.19

15766 THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. I. THE HOMOPOLAR CASE. H.Shull.

J. Amer. Chem. Soc., Vol. 82, No. 6, 1287-95 (March 20, 1960).

By using the artifice of dividing space into two parts by means of a plane perpendicular to the internuclear axis and passing through its midpoint, it is shown that there is possible a division of a two-configuration two-electron wave-function into two orthogonal parts each of which has optimum properties associated with the plane intuitively corresponding to the names "ionic" and "atomic." The division of the density distributions for the Wang, Weinbaum and Rosen functions into ionic, atomic and ionic-atomic cross-term parts is considered, and it is shown that the first two parts are roughly non-bonding, whereas it is the last part which contributes most to the density between the nuclei in the binding region. Analysis of the energetic parameters also leads to this conclusion. Consequently, the term covalent seems best applied to the cross-term. The analysis seems to supply the need for a sound theoretical basis to the kind of empirical concept embodied in the phrases "ionic and covalent character" but suggests that the language needs to be modified to some extent. The method is capable of extension to the heteropolar bond.

539.19

15767 DESTRUCTION OF DIATOMIC BONDS BY PRESSURE.
B.J.Alder and R.H.Christian.

Phys. Rev. Letters, Vol. 4, No. 9, 450-2 (May 1, 1960).

This has been observed as a first-order phase transition in iodine by means of shock techniques. The results are in agreement with empirical predictions based on the lengthening of diatomic bonds to metallic bonds. If the same order of change is assumed for hydrogen, the conditions for the existence of a monatomic phase are a compression of 30 times, and a pressure of 20 megabars.

P.Gray

539.19

15768 CALCULATION OF ENERGY LEVELS AND ELECTRON DISTRIBUTION IN REDUCED AND OXIDIZED FORMS OF DIPHOSPHORIDINE NUCLEOTIDE AND OF FLAVINE.
B.Grabe.

Ark. Fys., Vol. 17, Paper 5, 97-111 (1960).

Energy levels and electron densities are calculated in different oxidation states of diphosphopyridine nucleotide and flavine-adenine dinucleotide, both of which take part in the oxidative processes in the living cell. Only those parts of the molecules where oxidation and reduction take place are considered in the calculation. The π-electrons and some lone pairs in these parts are considered explicitly. Molecular orbitals (MO) for these "π-electrons" are formed by linear combination of atomic orbitals (LCAO). The antisymmetrized products (AP) of these orbitals are used. Some of the integrals in the electronic wave-equation are determined semi-empirically according to a treatment by Pariser and Parr and by Pople. The self-consistent field method (SCF) is used for solving the equations. In the discussion it is shown that the results seem to give considerable support to the hypothesis of the present author concerning the oxidative phosphorylation at the diphosphopyridine nucleotide and flavine molecules in the living cell.

539.19

15769 A ONE-CENTER WAVE FUNCTION FOR THE METHANE MOLECULE.
A.F.Saturno and R.G.Parr.

J. chem. Phys., Vol. 33, No. 1, 22-7 (July, 1960).

Slater orbitals, centred on the carbon nucleus and having variable orbital exponents and principal quantum number, are used to construct electronic wave-functions for the ground state of the methane molecule of the form

$$\psi = C_1(s^2s^{*2}p^6) + C_2(s^2s^{*2}p^5d) + C_3(s^2s^*fp^6) + C_4(s^2s^{*2}p^5f') + C_5(s^2s^{*2}p^5g).$$

Values for the five linear coefficients, the seven orbital exponents, and the seven principal quantum numbers are determined by the variational method. The total molecular energy obtained from a one-term wave function of this form is −39.50 a.u.; the five-term. result is −39.80 a.u.; the experimental nonrelativistic energy is −40.51 a.u. Comparison with a similar calculation for the neon atom indicates that most of the residual error is in correlation energy, and it favours the high value for the heat of sublimation of carbon.

539.19

15770 THEOREM ON SEPARABILITY OF ELECTRON PAIRS.
T.Arai..

J. chem. Phys., Vol. 33, No. 1, 95-8 (July, 1960).

The theorem that two functions $\Lambda_A(12$ and $\Lambda_B(12)$ span subspaces which are mutually perpendicular if the functions are orthogonal to each other in the strong sense:

$$\int \Lambda_A^*(12)\Lambda_B(13)\,d\tau_1 = 0,$$

is proved here. The theorem is important for the study of chemical bonds.

539.19

15771 THEORY OF SINGLET—TRIPLET SPLITTINGS IN LARGE BIRADICALS.
H.M.McConnell.

J. chem. Phys., Vol. 33, No. 1, 115-21 (July, 1960).

A perturbation calculation is used to estimate small ground-state singlet—triplet splittings in large biradicals in which two triphenylmethyl groups are bridged at para positions by polyene, polyphenylene, polymethylene, or ether groups. The calculated splittings are orders of magnitude larger than the rates of spin exchange reported by Reitz and Weissman (Abstr. 2614 of 1958) for some of these biradicals.

539.

15772 VARIATIONAL CALCULATION OF DIAMAGNETIC SUSCEPTIBILITIES, CHEMICAL SHIFTS AND ELECTRONIC POLARIZABILITIES.
Y.Kurita and K.Ito.

J. Amer. Chem. Soc., Vol. 82, No. 2, 296-8 (Jan. 20, 1960).

The variational method is applied to the calculation of the diamagnetic susceptibility χ and electronic polarizability α of molecu and of the magnetic shielding of nuclei in molecules σ. The formulae thus derived for χ and σ are identical with those previously proposed. The expression for χ gave satisfactory results when applie to the hydrogen molecule and the π-electron system of benzene. T applicability of the formulae for χ and σ is discussed.

539.

15773 POLARIZATION OF HYDROGEN NUCLEI IN A FREE RADICAL.
G.S.Lomkatsi.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 635-6 (Feb., 1960).
In Russian

Diphenylpicrylhydrazyl (DPPH) cooled to 4° K was exposed to three mutually perpendicular magnetic fields: constant, ultra-high frequency (ν_e) for saturating the paramagnetic resonance, (e.s.r.) and high frequency (ν_n) for observing the nuclear magnetic resona (n.m.r.) of protons. Contrary to theory, the n.m.r. signal was not enhanced by the factor $(\mu_n + s|\mu_e|)/\mu_n$ (where μ_n and μ_e are the magnetic moments of the proton and electron, respectively, and s is the saturation coefficient e.s.r.) at $H_0 = h\nu_e/2.003\ \mu_e$. It is deduced that, when the probabilities of the two kinds of transitions caused by u.h.f. are much greater than those of nuclear transitions caused by other processes, the signal/n.m.r. function will have, at constant microwave power and frequency, the form of two Gaussia distributions with half-widths equal to the sum of the half-widths o nuclear and electron spin resonances. The width of the e.s.r. line was found to depend considerably on temperature. The non-paired electron of the DPPH molecule can polarize not only the protons of its own molecule, but also those of distant molecules.

F.Lachma

539.1

15774 ELECTRON DIFFRACTION INVESTIGATION OF THE MOLECULAR STRUCTURES OF GALLIUM AND YTTRIUM HALIDES.
P.A.Akishin, V.A.Naumov and V.M.Tatevskii.

Kristallografiya, Vol. 4, No. 2, 184-200 (March-April, 1959).
In Russian. English translation in: Soviet Physics—Crystallograp (New York), Vol. 4, No. 2, 174-80 (Feb., 1960).

Radial distribution curves were obtained for these halides and theoretical intensity curves were calculated assuming both a monomer planar molecule and a dimer molecule (distorted tetrahedrons with common edge). The experimental data on the gaseous halides suggest that GaF_3 and GaI_3 have monomer structures while $GaCl_3$ and $GaBr_3$ have the dimer structure. The fluoride, chloride, bromide and iodide of yttrium showed the monomer structure. The geometrical structure parameters are tabulated.

J.E.Caffy

539.1

15775 MOLECULAR STRUCTURE OF IODINE HEPTAFLUOR
R.E.LaVilla and S.H.Bauer.

J. chem. Phys., Vol. 33, No. 1, 182-6 (July, 1960).

Electron diffraction photographs taken in 1951 are reanalysed. All measurements and intensity estimates had been made visually; in the computations, allowance is made for the relative phase chang of the scattering amplitudes between the iodine and fluorine atoms. Within a spread of 0.06 A, the I—F distances are approximately equal; the average value is 1.825 ± 0.015 A. The molecular symmetry is almost D_{5h} in agreement with spectroscopic and crystal structure results. However, the electron diffraction patterns clearly indicate that the five fluorine atoms in the girdle are not coplanar and possibly are not equally spaced from the central iodine. The disorder reported in the crystalline state and the unusually broad n.m.r. spectra of the liquid are readily accounted fo by a sequential puckering about the polar axis and the possible out-of-phase extension from the axis of the girdle atoms. Revised values for the thermodynamic functions of the ideal gas are include

539.19

5776 MOLECULAR STRUCTURE CORRELATIONS.

B.Bak and L.Hansen-Nygaard.

iem. Phys., Vol. 33, No. 2, 418-23 (Aug., 1960).

The molecular structure of methane, ethane, ethylene, acetylene, l fluoride, benzene, butadiene, allene, butatriene, propylene, ooctatetraene, methyl acetylene, diacetylene, methyl cyanide, ıyl isocyanide, vinyl cyanide, carbon dioxide, formaldehyde, aldehyde, propynal, acrolein, formic acid, methyl formate, ıamide, and acetyl cyanide (25 molecules) have be correlated by ns of a set of empirical parameters, the physical meaning of h is discussed in part.

539.19

5777 SECOND DIFFERENCES OF MOMENTS OF INERTIA IN STRUCTURAL CALCULATIONS : APPLICATION METHYL-FLUOROSILANE MOLECULES.

.Krisher and L.Pierce.

hem. Phys., Vol. 32, No. 6, 1619-25 (June, 1960).

An extension and application of the method proposed by Pierce str. 5984 of 1960) for the location of "near-axis atoms" from ctroscopically determined moments of inertia is made. Equations derived which are required for the application of the method to mmetric top molecules with C_S symmetry. The method is applied he determination of silicon coordinates in the molecules SiH_2F and CH_3SiHF_2. The experimental results are combined ı results of previous microwave investigations of these molecules rder to determine their structures. Addition of each fluorine n lowers the SiC distance. The SiF distance is lowered on ing the second fluorine. In the case of CH_3SiHF_2 the equilibrium formation (staggered) is also determined.

539.19

1577 THE MOLECULAR STRUCTURES OF n-PENTANE, n-HEXANE AND n-HEPTANE.

.Bonham, L.S.Bartell and D.A.Kohl.

Amer. Chem. Soc., Vol. 81, No. 18, 4765-73 (Sept. 20, 1959).

The molecular structures of gaseous n-pentane, n-hexane and ıeptane were investigated by the sector-microphotometer method electron diffraction. The bond lengths for the molecules in the ve order, were found to be, in terms of centre of gravity parameters C—H = 1.118 ± 0.004 A., 1.118 ± 0.0066 A., 1.121 ± 0.0007 A.; C = 1.531 ± 0.002 A., 1.533 ± 0.003 A., 1.534 ± 0.003 A. Angles culated from r_g internuclear distances were: <C—C—C = 112.9 ± 0.2°, .9 ± 0.4, 112.6 ± 0.3°; <C—C—H = 110.4 ± 0.3, 109.5 ± 0.5°, ,8 ± 0.5°. Root-mean-square amplitudes of vibration were: H = 0.083 ± 0.004 A., 0.080 ± 0.005 A., 0.078 ± 0.007 A.; C = 0.0575 ± 0.003 A., 0.0575 ± 0.003 A., 0.051 ± 0.003 A., ·H = 0.116 ± 0.005 A., 0.123 ± 0.005 A., 0.104 ± 0.005 A.; ·C = 0.080 ± 0.004 A., 0.080 ± 0.004 A., 0.076 ± 0.004 A. The -systematic standard errors estimated from least squares and er information were found to agree very closely with the root-an-square deviations between corresponding parameters for the ve three molecules and n-butane, which was investigated recently, a comparison including 40 independent parameters. The observed xibility of the hydrocarbon chains was compatible with that imed by internal rotational barriers deduced by Pitzer from heat acity data.

539.19

15779 ON THE GEOMETRICAL STRUCTURE OF BENZENE—IODINE COMPLEX. S.Aono.

ogr. theor. Phys., Vol. 21, No. 1, 217-18 (Jan., 1959).

Discusses whether the structure belongs to the symmetry $_v$ or C_6.

539.19

15780 DIPOLE MOMENTS AND RELAXATION TIMES OF SOME HALOGENATED DISUBSTITUTED BENZENES.

N.Srivastava.

sci. industr. Res., Vol. 19B, No. 5, 149-51 (May, 1960).

Dipole moments and relaxation times of o-, m- and p-chloro-ilines, o- and m-bromoanilines, o-bromophenol, o-dichlorobenzene, cresol and p-toluidine were determined in benzene at 9516 Mc/s d at a temperature of 40° C. It has been found that relaxation ne increases from o- to m- and from m- to p-chloroaniline. For bromoanilines also, the relaxation time increases from o- to m-. laxation times of o- and m-bromoanilines are greater than those the corresponding chloroanilines. It was also observed that icrowave absorption in halogenated disubstituted benzenes is due the rotation of the entire molecule.

539.19

15781 HYDROGEN BRIDGE LENGTHS AND ORIENTATION OF THE FOUR TYPES OF WATER OF CRYSTALLIZATION MOLECULE IN ROCHELLE SALT. M.P.Bernard.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3819-21 (June 8, 1960). In French.

The four water molecules are bound to the tartrate ion by a series of hydrogen bridges (O—H ... O). The lengths of these bridges the H—O—H apex angles, and the arrangement of the Rochelle salt unit cell are determined. Using infrared polarization data for different crystal directions the water molecules are classified in terms of the force constants of the 4 pairs of (O—H ... O) oscillators. One molecule is unusual in that its oxygen atom forms a hydrogen bridge with one of the other water molecules. D.L.Greenaway

539.19

15782 APPLICATION OF LEAST-SQUARES METHOD TO GASEOUS BENZENE IN ELECTRON DIFFRACTION INVESTIGATION. K.Kimura and M.Kubo.

J. chem. Phys., Vol. 32, No. 6, 1776-80 (June, 1960).

The intensity data of gaseous benzene obtained at 18° C by the sector-microphotometer technique in electron diffraction were analysed by use of a least-squares method, D_{6h} symmetry being assumed for the molecule. A total of thirteen parameters comprising two bond distances, seven root-mean-square amplitudes, three background parameters, and one intensity scale factor were refined in the least-squares treatment. Uncertainties in these parameters were determined by computing standard errors due to the over-all errors involving systematic and random errors. Results for bond distances r and root-mean-square amplitudes l are as follows: $r(C{-}C) = 1.396_9 \pm 0.003$ A; $r(C{-}H) = 1.084_5 \pm 0.0020$ A; $l(C_1{-}C_2) = 0.045_6 \pm 0.003$ A; $l(C_1 \ldots C_3) = 0.055_5 \pm 0.005$ A; $l(C_1 \ldots C_4) = 0.061_4 \pm 0.009$ A; $l(C_1{-}H_1) = 0.074_8 \pm 0.010$ A; $l(C_1 \ldots C_3) = 0.097_5 \pm 0.008$ A; $l(C_1 \ldots H_3) = 0.092_5 \pm 0.016$ A; $l(C_1 \ldots H_4) = 0.096_0 \pm 0.0023$ A. These values were compared with data available in the literature. An empirical formula is proposed for experimental background scattering and the selection of weighting factors in least-squares refinement is discussed.

539.19

15783 ROTATIONAL ISOMERISM INVOLVING THE 2-3 CARBON—CARBON BOND OF THE 1-ALKENES.

L.A.Harrah and D.W.Mayo.

J. chem. Phys., Vol. 33, No. 1, 298-9 (July, 1960).

The infrared spectra of a series of 1-alkenes up to 1-hexadecene, show bands at 550 cm^{-1} and 630 cm^{-1}, except in the case of propene. On crystallization of the alkene, the band at 550 cm^{-1} disappears and that at 630^{-1} intensifies. The bands are ascribed to the ethylenic twisting vibrations of two conformational isomers, in which the vinyl group is orientated differently with respect to the remaining structure. The envelope of the band at 550 cm^{-1} indicates a nearly planar carbon skeleton, which does not persist on crystallization. J.Sheridan

539.19 : 539.2 : 548.7

MOLECULAR STRUCTURES OF THE ALUMINIUM HALIDES.

See Abstr. 14007

539.19 : 537.52

SPARKING POTENTIAL AND MOLECULAR STRUCTURE OF UNSATURATED HYDROCARBON GASES.

See Abstr. 14999

539.19

15784 THE ROLE OF UNIVERSAL AND SPECIFIC INTERMOLECULAR INTERACTIONS IN THE EFFECT OF A SOLVENT ON THE ELECTRONIC SPECTRA OF MOLECULES.

B.S.Neporent and N.G.Bakhshiev.

Optika i Spektrosk., Vol. 8, No. 6, 777-86 (June, 1960). In Russian.

Intermolecular interactions in solutions are divided into two main types: universal, due to the collective effect on the solute molecule of all the surrounding solvent molecules, and specific, due to individual interactions of the solute molecule with one or more of the surrounding solvent molecules. The universal interactions are "macroscopic" effects of the solvents described by properties such as permittivity, refractive index, dispersion, etc. The specific interactions are affected by the structure of the solvent molecules and are called "microscopic" effects. Internal fields in a solution are used to separate the universal from specific interactions. Numerous and varied experimental data are employed to show the applications of these ideas. A.Tybulewicz

539.19

15785 INTERACTION ENERGIES FOR THE $H-H_2$ AND H_2-H_2 SYSTEM. J.T.Vanderslice and E.A.Mason.

J. chem. Phys., Vol. 33, No. 2, 492-4 (Aug., 1960).

Interaction energies are obtained by a semiempirical perfect-pairing procedure used previously. The results are compared with interaction energies obtained from other sources and the agreement among the different curves is reasonably good. A brief discussion of the previous applications of this semiempirical scheme to other systems is included.

539.19

15786 UNLIKE MOLECULAR INTERACTIONS FROM VISCOSITY AND INTER-DIFFUSION. A.K.Barua.

Indian J. Phys., Vol. 33, No. 9, 221-8 (May, 1959).

Force constants for unlike molecular interactions for the systems H_2-CH_4, H_2-CO_2, H_2-H_2, H_2-He, $N_2-C_2H_4$ for the Lennard-Jones (12 : 6), model have been determined by combining the data on inter-diffusion coefficient and viscosity of gas mixtures. To test the appropriateness of the force constants thus determined, the available experimental data have been compared with the values of the viscosity, inter-diffusion and thermal diffusion calculated by utilising these force constants and satisfactory agreement has been obtained. From the available data it appears that the force constants give better agreement than those obtained from the usual combination rules.

539.19

15787 VIBRATIONAL TRANSITIONS AND THE INTERMOLECULAR POTENTIAL. R.C.Amme and S.Legvold.

J. chem. Phys., Vol. 33, No. 1, 91-5 (July, 1960).

Temperature-dependence studies of vibrational collision lifetimes indicate that the application of the Schwartz, Slawsky and Herzfeld theory (Abstr. 348 of 1953) to substituted methane molecules with heavy surface atoms results in repulsive ranges which are shorter than those expected from a Lennard-Jones 6 : 12-type interaction. It is shown that the 28 : 7 potential suggested by Hamann and Lambert [Australian Journal of Chemistry, Vol. 7, 1 (1954)] for quasi-spherical molecules gives ranges which are in better agreement with experiment. Also, experimental relaxation times of $CHClF_2$—argon and $CHClF_2$-helium mixtures have been used to obtain the collision lifetimes for the $CHClF_2$ molecule undergoing either argon or helium collisions. The results can be explained using the SSH theory, if the 6 : 12 ranges for helium and argon are averaged with the shorter experimental range for $CHClF_2$.

539.19

15788 MOLECULAR COLLISION CROSS SECTIONS FROM INFRARED ABSORPTION MEASUREMENTS.

H.Babrov, G.Ameer and W.Benesch.

J. chem. Phys., Vol. 33, No. 1, 145-50 (July, 1960).

Through measurement of the equivalent width (fractional integrated absorption) of collision-broadened lines of the P branch of the HCl fundamental vibration-rotation band at 3.5 μ, the Lorentz half-widths of these lines were determined and optical collision cross-sections deduced. The cross-sections obtained are those for collisions between HCl molecules and A, CO_2, CO, D_2, H_2, HBr, He, Ne, N_2, O_2, as well as other molecules of HCl. One of the more interesting aspects of these cross-sections is their dependence on the rotational state of the absorbing molecule and the various forms which this J dependence takes for the different foreign gases. The line-widths range between the extremes of 0.233 and 0.0111 cm^{-1} atm^{-1} while the collision cross-sections range between 3.04×10^{-14} and 0.091×10^{-14} cm^2. Also reported are recently measured values of the strengths for the first eight lines of the P branch of the HCl fundamental. The strength of this band based on these measurements has been found to be 143 ± 5 cm^{-2} atm^{-1} at 300°K.

539.19

15789 PERTURBATION TREATMENT OF THE CHARACTERISTIC VIBRATIONS OF POLYPEPTIDE CHAINS IN VARIOUS CONFIGURATIONS. T.Miyazawa.

J. chem. Phys., Vol. 32, No. 6, 1647-52 (June, 1960).

A perturbation treatment has been made of localized group vibrations of helical polymer chains. The amide I and II frequencies were derived in terms of adjacent group interactions as well as interchain and intrachain hydrogen bonding interactions. Frequency shifts caused by these interactions depend upon the configuration of polypeptide chains and also upon the chain packing in the crystalline region. Each characteristic vibration of the amide group gives rise to parallel and perpendicular bands. The parallel bands of the α helix of poly-γ-benzyl-L-glutamate were observed at 1650 cm^{-1} (amide I) and 1516 cm^{-1} (amide II) whereas the perpendicular ban were observed at 1652 cm^{-1} (amide I) and 1546 cm^{-1} (amide II). B the parallel-chain and antiparallel-chain pleated sheets exhibit t perpendicular amide I band at ~1630 cm^{-1}. A characteristic band of β configurations at ~1690 cm^{-1} was assigned to the parallel an I band of the antiparallel-chain pleated sheet.

539

15790 NEIGHBOR INTERACTIONS AND INTERNAL ROTATIONS IN POLYMER MOLECULES. IV. SOLV EFFECT ON INTERNAL ROTATIONS. S.Lifson and I.Oppenhein

J. chem. Phys., Vol. 33, No. 1, 109-15 (July, 1960).

For Pt III, see Abstr. 8771 of 1959. Solvent chain-element interactions affect the probability distribution of the angles of internal rotation of a polymer chain and give rise to an average torque on the skeletal bonds of the chain. The average torque an its potential are derived in terms of polymer—solvent interactio potentials and reduced distribution functions. The energy of the polymer molecule, as it was applied in the previous papers of thi series, is shown to be the potential of the average torque in the neighbour interaction approximation. This approximation, though insufficient by itself, provides a theoretical basis for the applica of the random flight model of polymer molecules and, at the sam time, improves upon it by deriving the characteristic parameter the model (the length of the statistical chain element) as a functi of temperature, solvent, and the structural parameters of the pol chain. Following these considerations, the complementary natur of the theories of neighbour interaction and excluded volume is discussed.

53

15791 EXCLUDED VOLUME EFFECT OF LINEAR POLYM MOLECULES. M.Kurata, W.H.Stockmayer and A.Roi

J. chem. Phys., Vol. 33, No. 1, 151-5 (July, 1960).

A new closed expression for the excluded volume effect of li polymer molecules is developed with the aid of an equivalent elli soid model, in which the polymer chain with fixed ends is replac by a uniform distribution of unconnected segments within an ellip whose dimensions are chosen to give the correct principal radii gyration of the chain. The linear expansion factor α for a chain N segments is given by

$$(\alpha^3-\alpha)/N^{1/2} = \{(1+\tfrac{1}{3}\alpha^{-2})^{-3/2}\}^{-1}(4/3)^{5/2}(3/2\pi)^{3/2}(\beta/a^3)$$

where a is the effective bond length and β is the binary cluster integral of a segment pair. In contrast to Flory's familiar equat the ratio $(\alpha^5-\alpha^3)/N^{1/2}$ is an increasing function of α instead of a constant. The new equation is in excellent agreement with the M Carlo calculations of Wall and Erpenbeck (Abstr. 7479 of 1959) f diamond lattice chain and also with existing viscosity data for va polymer solutions, provided that the expansion factor is evaluate from the equation $[\eta]/[\eta]_\theta = \alpha^{2.43}$ in accord with the theories of Kurata—Yamakawa and Ptitsyn—Eisner. It is also shown that th present equation for α is in rather good agreement with the nun cal solution of Fixman's differential equation.

539.19 : 5

OSMOTIC PRESSURE OF MODERATELY CONCENTRATED POLYMER SOLUTIONS. See Abstr. 14641

53

15792 THE b_{1u} METHYLENE WAGGING AND TWISTING FUNDAMENTALS IN CRYSTALLINE POLYETHYLE

J.R.Nielsen and R.F.Holland.

J. molecular Spectrosc., Vol. 4, No. 6, 488-98 (1960).

It is shown that the infrared band at 1368 cm^{-1}, previously a signed as the b_{1u} methylene wagging mode in crystalline polyeth lene, is caused by the amorphous phase and that the bands obse at 1368 and 1370 cm^{-1} in crystalline n-$C_{36}H_{74}$ and n-$C_{46}H_{94}$, resp tively, must be ascribed to symmetrical methyl deformation. T possibility that the b_{1u} methylene wagging fundamental is maske the methylene deformation bands is discussed and discarded. It concluded that the b_{1u} methylene fundamental must be identified the very weak, parallel band at 1176 cm^{-1}, and some support is for this assignment. It is suggested that the parallel band at 1050 is caused by methylene twisting rendered infrared-active by int chain coupling.

53

15793 STATISTICAL MECHANICS OF MACROMOLECULE CHAINS IN VELOCITY FIELD. R.Cerf.

J. Phys. Radium, Vol. 19, No. 2, 122-34 (Feb., 1958). In Frenc

The theory introduces the internal viscosity by means of no linates. The macromolecule is characterized by the molecular it M, the intrinsic viscosity at zero gradient $[\eta]_0$ and the inter- iscosity coefficient F, which is constant for a series of homolog- olymers. Flow birefringence and non Newtonian viscosity data exible-chain molecules in dilute solutions are explained almost itatively by this theory. It appears that the coefficient F can be y obtained from measurements of viscosity as a function of ent.

539.19

5794 EFFECT OF SOLVENT AND OF THE SPECIFIC NATURE OF THE ADDITION OF NUCLEOTIDES ON REDUPLICATION OF DESOXYRIBONUCLEIC ACID.

Vol'kenshtein and A.M.El'yashevich.
. Akad. Nauk SSSR, Vol. 131, No. 3, 538-41 (March 21, 1960).
ıssian.

The effect of the reaction between desoxyribonucleic acid (DNA) water, the specific nature of the addition of various nucleotides the elasticity of the DNA chain on reduplication of DNA is ained using the model statistical reduplication theory 'kenshtein, Dokl. Akad. Nauk SSSR, Vol. 130, No. 4, 889 . 1, 1960)]. It is shown for example that the concentration of eotides, required for reduplication, is larger by a factor of n that calculated without taking into account the specific re of nucleotides. The fate of DNA depends of the elasticity e chain and on the difference of solvation and polymerization gies. F.Lachman

539.19

5795 TOTAL COLLISION CROSS SECTIONS FOR THE INTERACTION OF MOLECULAR BEAMS OF CESIUM ORIDE WITH GASES. INFLUENCE OF THE DIPOLE—DIPOLE CE UPON THE SCATTERING.

humacher, R.B.Bernstein and E.W.Rothe.
ıem. Phys., Vol. 33, No. 2, 584-90 (Aug., 1960).

Total cross-sections (Q) for the interaction of beams of CsCl a number of molecules were measured using an apparatus of 4' angular resolution in which the temperature of the scattering could be varied from 200°-735° K. The temperature dependence of Q was studied for A, CH_4, CH_2F_2, CHF_3, CF_4, NO, H_2S, NH_3, and for cis- and trans-CHCl=CHCl. Relative values of Q at 300° K were measured for eight additional gases. The data were correlated using the Massey—Mohr theory, assuming an intermolecular potential $V(r) = -C/r^6$, so that $Q = b(C/v_r)^{2/5}$, where v_r is the relative velocity and b a known constant; the potential constant C was estimated from formulae for the dispersion, dipole-induced dipole, and dipole—dipole forces. For the nonpolar gases the observed small temperature dependence of Q agrees within experimental error (±3%) with that expected from the temperature dependence of v_r. The theoretical values of Q differ by a nearly constant factor from the experimental results; thus relative cross-sections (Q*) are predicted with fair accuracy. For the polar gases the Q's are large, decreasing significantly with increasing temperature. Because of the large dipole—dipole interaction, the approximate theoretical treatment (based on the limiting temperature-dependent dipole—dipole contribution to C) accounts only semiquantitatively for the observations.

539,19

15796 IMPROVED SLOTTED DISK TYPE VELOCITY SELECTOR FOR MOLECULAR BEAMS.

H.U.Hostettler and R.B.Bernstein.
Rev. sci. Instrum., Vol. 31, No. 8, 872-7 (Aug., 1960).

A slotted disk type mechanical velocity selector, 10 cm long and 16 cm in diameter, consisting of six disks has been constructed and tested. The velocity resolution corresponding to the half-intensity width is 0.047; no velocity sidebands are transmitted. The effective fractional open time to the incident beam is 0.35. At the highest rotor speed used (17 000 r.p.m.) the transmitted velocity is 1.05×10^5 cm/sec. A general theoretical analysis of the transmission and resolution of selectors with disks of finite thickness is presented. The velocity distribution is reported for a molecular beam effusing from an oven equipped with Zacharias corrugated foil exit canals.

539.19 : 536.42

DEPOSITION FROM A MOLECULAR BEAM ONTO A COLD TARGET SURFACE. See Abstr. 14888

SOLID-STATE PHYSICS

539.2

15797 RELATIONSHIPS BETWEEN PROPERTIES OF ATOMS AND CRYSTALS. L.M.Shestopalov.

tverdogo Tela, Sbornik [Supplement] I, 228-35 (1959). In sian.

Discusses the condensation of atoms to form a solid (a crystal), ng the electron structure of atoms, the quantum states of the r electrons and the excitation of electrons in unfilled inner shells ransition elements. Shows that differences in the structure of al atoms in the condensed state, inexplicable on the electron ry of metals, can be accounted for satisfactorily by the author's ry. The same theory is used to explain the differences between low-temperature properties of metal crystals of various ctures. A.Tybulewicz

539.2

5798 A GENERALIZATION OF GRÜNEISEN'S THEORY OF SOLIDS AND ITS APPLICATION TO SOLID ARGON.

.Davies and S.Parke.
1. Mag. (Eighth Ser.), Vol. 4, 341-58 (March, 1959).

The quasi-harmonic model of a solid (a harmonic model which es only partial account of anharmonicity) is examined and a eral notation established. The theory involves the quantities

$$[\epsilon_i]^{[n]} \equiv (V^n/\nu_i)\,(\partial^n\nu_i/\partial V^n),$$

re ν_i are the spectral frequencies. By evaluating averages of $^{[n]}$ appropriate at high and low temperatures it is shown that neisen-type assumptions are reasonable for the inert gas solids. s confirms work by Barron on Grüneisen's γ (in this notation $-\langle[\epsilon_i]^{[1]}\rangle_{Av}$). Grüneisen's equation of state

$$pV = -VU_0'(V) + \gamma U_T,$$

re U_T and U_0 are the thermal and non-thermal contributions to the internal energy U, is extended to yield an equation of the form

$$V/\kappa_T = V^2U_0''(V) + \gamma' U_T - \gamma^2 TC_V,$$

where $\gamma'(=\langle[\epsilon]^2\rangle_{Av})$ is a "second" Grüneisen constant. It may be estimated from measurements of the variation of compressibility with temperature in much the same way as the first Grüneisen constant γ is determined from measurements on expansivity, specific heat and compressibility. Experimental results for argon are compared with the theory, assuming a Lennard-Jones 6-12 potential. Good agreement is obtained except above 40° K where anharmonicity must be considered explicitly. Estimates of γ are consistent with those of previous writers; it is concluded from theory that for argon γ' has a value of about 10, and is confirmed by a direct use of experimental results on compressibility.

539.2

15799 A NOTE ON THE THEORIES OF METALS AND OF PRESSURE IONIZATION. S.K.Trikha.

Progr. theor. Phys., Vol. 21, No. 1, 212-14 (Jan., 1959).

The degree of ionization of an assembly of atoms at high pressure p and low temperature T is expressed in terms of T and p. Applications to metals and to the interior of a white dwarf star are mentioned. D.M.Edwards

539.2 : 539.219

15800 THE LATTICE STABILITY OF METALS. I. TITANIUM AND ZIRCONIUM. L.Kaufman.

Acta metallurgica, Vol. 7, No. 8, 575-87 (Aug., 1959).

The difference in free energy between the b.c.c. and h.c.p. modifications of titanium and zirconium have been calculated between 0° K and 200° K by using existing thermodynamic data. These results have been employed to investigate the energetics of the b.c.c. ⇌ h.c.p. reactions in the Ti—Zr system and in a series of titanium-base alloy systems. It is found that the chemical driving force for martensitic b.c.c. → h.c.p. reactions in these systems is about 50 cal/mol. This value, compared to 300 cal/mol for iron-base alloys, can be explained by the difference in physical characteristics of martensitic transformations in iron-base and in titanium-base alloys. A method is suggested for estimating M_S versus composition curves for titanium and zirconium-base systems where such data are presently unavailable.

539.2

15801 A HIGHER APPROXIMATION IN EWALD'S METHOD. V.S.Mashkevich.

Fiz. tverdogo Tela, Vol. 2, No. 5, 908-12 (May, 1960). In Russian.

Ewald's theory of the internal electric field in a crystal includes electromagnetic interactions between crystal particles. The present paper derives the corresponding electromagnetic field for multipoles of any order, in the form of an expansion in powers of the ratio of the lattice constant to the wavelength. A.Tybulewicz

539.2

15802 METALLIC TRANSITIONS IN IONIC CRYSTALS: SOME GROUP THEORETICAL RESULTS.

M.Flower, N.H.March and A.M.Murray.

Phys. Rev., Vol. 119, No. 6, 1885-8 (Sept. 15, 1960).

In view of a discrepancy between results available in the literature, the problem of finding the different irreducible representations for points on the surface of the Brillouin zone in NaCl and CsCl type lattices is re-examined for particular points of high symmetry. The lattice harmonics to be included in cellular-type calculations are listed up to and including $l = 10$ for two points on the surface of the Brillouin zone in each case. These results confirm the earlier work of Bell (Abstr. 11539 of 1954) up to $l = 6$, and extend her tables somewhat. The present findings however are at variance with Behringer's work on LiH (Abstr. 6276 of 1959) for one of the points (W) which he considers.

539.2

15803 CONTRIBUTION TO THE THEORY OF PHASE TRANSITIONS IN MOLECULAR CRYSTALS.

V.I.Klyachkin.

Fiz. tverdogo Tela, Vol. 2, No. 5, 929-39 (May, 1960). In Russian.

It is assumed that the molecules in a crystal are free to rotate and are aligned by an angular potential energy of interaction between nearest neighbours. In this case a transition from restricted to unrestricted rotation is to be anticipated. The (classical) theory of this transition is based on a set of simultaneous integral equations (due to Bogolyubov) in which the angular singlet distribution is expressed in terms of the angular doublet distributions for pairs of neighbouring molecules. These equations are similar to Born and Green's equations for molecular distributions in fluids and, like the latter, they are solved by the way of the superposition approximation. It is found that the onset of free rotation is a second order transition. R.Eisenschitz

539.2

15804 MOLECULAR ROTATION IN CRYSTALS OF N_2 AND CO. B.C.Kohin.

J. chem. Phys., Vol. 33, No. 3, 882-9 (Sept., 1960).

In this study, the following contributions to the crystal field hindering free rotation are taken into account: (a) the interaction of the molecular quadrupoles; (b) the effect of the anisotropic molecular polarizabilities; and (c) the short-range repulsive forces. The results of a theoretical calculation of the minimum-energy configuration at 0° K support the generally accepted structure; it is shown that the crystal field in this structure is axially symmetric at each lattice site. The Schrödinger equation for a rigid rotor in the crystal field is solved for the lowest rotational states of N_2 and CO. It is found that a classical treatment of the rotation is not justified for these crystals due to the large separations of the lowest eigenvalues. The zero-point energy of rotation is found to be about half as large as the zero-point vibrational energy for these crystals.

539.2

15805 A MODIFICATION OF PAULING—FOWLER'S THEORY OF THE INTERNAL ROTATION IN CRYSTALS.

V.Sergiescu.

Stud. Cercetari Fiz., Vol. 10, No. 1, 99-109 (July, 1959). In Roumanian.

The Pauling—Fowler theory of the internal rotation in solids is modified as follows (1) Because of the anisotropy, the mechanical couple associated with each molecule does not vanish as the degree of non-rotation tends to zero. (2) A new definition of the degree of non-rotation is given (applying to the interval of temperature above the Curie point), related to the rotation "intensity" (i.e. rotation speed). This simple generalization yields a better agreement with the experimental facts, namely a continuous specific heat passing through a sharp maximum and a cooperative parameter tending to zero at infinite temperature only.

539

15806 BEHAVIOUR OF SULPHUR UNDER THE ACTION OF A SHOCK WAVE. J.Berger, S.Joigneau and G.Bottet.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4331-3 (June 27, 1960). In French.

It is shown that the transition to the metallic state already observed is associated with a discontinuity of the dynamic adiabati which is due to fusion. It is estimated that fusion will occur in shocks exceeding 90 kbar. P.Gr

539

15807 SOME THERMAL DATA FOR Bi_2Te_3. G.F.Bolling.

J. chem. Phys., Vol. 33, No. 1, 305-6 (July, 1960).

The data are: latent heat of fusion = 29.0 ± 1.0 kcal/mole; specific heat, C_p (accurate within ± 2%) = $36.00 + 1.305 \times 10^{-2}T - - 3.115 \times 10^{-5}T$ cal per degree per mole. The measurement techniques are described. W.Go

539

15808 MELTING POINT OF POTASSIUM AT PRESSURES UP TO 30 000 kg/cm². E G.Ponyatovskii.

Kristallografiya, Vol. 3, No. 4, 508 (1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3 No. 4, 512 (July-Aug., 1958).

The data obtained for the fusion curve of 99.9% potassium, additionally purified by triple distillation, for pressures 0-30 000 kg/cm² are shown and compared with Bridgman's. The melting point was determined by the thermal analysis method, with photographic recording of the heating and cooling curves, and the press and temperatures measured to accuracies of ±100 kg/cm² and ±1.5° C respectively. S.Weintro

539

15809 INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF FINE STRUCTURE OF THE FUNDAMENT EDGE OF X-RAY ABSORPTION SPECTRA OF TITANIUM IN BARIUM TITANATE NEAR THE CURIE POINT FOR $BaTiO_3$.

M.N.Bril'.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 3, 535-7 (March 21, 1960). In Russian.

It is shown that the fine structure in the X-ray absorption edg of titanium in barium titanates is different for different ratios of BaO to TiO_2. This was observed over the range of temperatures (20-200° C). In the monotitanate the fine structure becomes less distinct as the temperature is increased. In non-ferro-electric barium tetratitanate there is practically no dependence of the fine structure on temperature. Z.Krasuc

Lattice Dynamics

539

15810 MAGNETOACOUSTIC OSCILLATIONS AND THE FER SURFACE IN ALUMINUM. B.W.Roberts.

Phys. Rev., Vol. 119, No. 6, 1889-96 (Sept. 15, 1960).

Measurements of magnetoacoustic attenuation in very pure Al were made with 10 to 100 Mc/s longitudinal sound waves in magne fields up to 9200 Oe at a temperature of 4.2° K. The observed osc lations, or geometric resonances, for various crystal and field orientations may be interpreted utilizing the second zone of the nearly free electron Fermi surface model proposed by Harrison (Abstr. 2805, 9887-8 of 1960). The data suggest regions of high scattering near [100] portions of the surface that prevent the obser ation of periods for some orbit configurations.

539.2 : 536

15811 HEAT CAPACITY OF URANIUM TETRAFLUORIDE FROM 1.3° TO 20° K AND THE THERMODYNAMIC FUNCTIONS TO 300° K. CALORIMETER FOR THE RANGE 0.8° TO 20° K. J.H.Burns, D.W.Osborne and E.F.Westrum, Jr.

J. chem. Phys., Vol. 33, No. 2, 387-94 (Aug., 1960).

The heat capacity was determined in an isothermal calorimet with an integral gas thermometer and vapour-pressure bulb for ca bration of a carbon resistance thermometer. The enthalpy, en opy, and free-energy functions were evaluated from these data an previous measurements at higher temperatures. At 298.15° K, values of S°, $(H^\circ - H_0^\circ)/T$, and $-(F^\circ - H_0^\circ)/T$ are 36.25 ± 0.04, 08 ± 0.02, and 18.17 ± 0.02 cal mole^{-1} deg^{-1} for uranium tetra- ride. A Schottky-type anomaly occurs in the heat capacity at K, presumably as a consequence of ligand-field splitting of the el tronic energy levels.

539.2 : 536.63

15812 THE HEAT CAPACITY OF PURE SILICON AND GERMANIUM AND PROPERTIES OF THEIR VIBRA- NAL FREQUENCY SPECTRA.

'lubacher, A.J.Leadbetter and J.A.Morrison.

l. Mag. (Eighth Ser.), Vol. 4, 273-94 (March, 1959).

Heat capacities of pure silicon and germanium have been asured between 2.5° and 300°K. The estimated accuracies of the asurements are ±0.5% for $10^\circ < T < 20^\circ$K and ±0.2% for $T > 20^\circ$K. results for silicon were anomalous in the region $T < 7^\circ$K; it is gested that this behaviour resulted from adsorption and desorp- n of exchange gas in the calorimeter vessel. No anomalies were erved in the measurements on germanium; their accuracy at the est temperatures is estimated to be ±2%. The results for both stances are significantly different from previously published ues. The temperature variation of Θ_D of both silicon and german- n below about $T = \Theta_D/3$ is consistent with general harmonic ory, but at high temperatures Θ_D decreases with increasing tem- ature. This appears to be a clearly marked anharmonic effect of ype that cannot be explained by change of volume alone The re- ts for $T < \Theta_D/3$ are therefore extrapolated to high temperatures give a heat capacity consistent with harmonic theory at all tem- atures. From this, properties of an effective harmonic spectrum derived; these include the low frequency expansion and a number positive and negative moments. The apparent anharmonic contri- ion $\Delta C_V = [C_V - C_V \text{ (harmonic)}]$ is found for both elements to be proximately a linear function of the temperature in the region be- een $\Theta_D/3$ and room temperature. The possible significance of s result is discussed in the light of anharmonic theory. The re- lts are compared where possible with vibrational properties ermined from other experiments and the agreement is very satis- tory.

539.2

15813 SPECIFIC HEATS OF LITHIUM ISOTOPES FROM 20° TO 300°K. D.L.Martin.

ysica, Vol. 25, No. 11, 1193-9 (Nov., 1959).

Measurements on lithium metal containing 99.3% Li^6 are ported. The details of the martensitic transformation appear to very similar to those for lithium with natural isotopic composi- n. These measurements together with other recent results for ^{7} rich metal are analysed to give approximate values for the pure otopes. The results are in accord with theoretical expectations.

539.2

15814 X-RAY MEASUREMENTS OF THE THERMAL EXPANSION OF SODIUM NITRATE. M.Kantola and E.Vilhonen.

n. Acad. Sci. Fennicae, A VI, No. 54, 10 pp. (1960).

The cell constants of sodium nitrate at temperatures 23-300° C ve been measured. The thermal expansion coefficients of the cell nstants have been calculated from the measurements. The results ow that the values of the cell constants at different temperatures ported in the literature are not correct, for in most cases the -unit has been reported as the dimension of cell constants, though e correct dimension is the kX-unit. The thermal expansion of dium nitrate is strongly anisotropic; the expansion is greatest ong the hexagonal c-axis. At the end of this investigation it has en shown how the different thermal expansion of the cell constants a substance can be used by indexing Debye—Scherrer powder otographs.

539.2 : 536.41

15815 THE THERMAL EXPANSION COEFFICIENTS OF KCl, KBr AND THEIR SOLID SOLUTIONS IN THE TEMPERA- URE INTERVAL –180 TO 400° C. K.E.Salimäki.

nn. Acad. Sci. Fennicae A VI, No. 56, 33 pp. (1960). In German.

The measurement of the linear expansion coefficients of KCl d KBr single crystals and of the mixed crystals containing 25, 50 d 75 mol. % KCl over the temperature range –180 to 400° C is escribed in detail. The crystals were 30 to 50 mm long and of 1 cm^2 ross-sectional area. They were grown by slow solidification from e melt in quartz or platinum crucibles. The dilatometer used is described and shown diagrammatically. The temperature range was covered in two stages, with liquid-air cooling for –180 to 100° C and electrical heating in a thermostatted furnace for room temperature to 400° C. A microscope was used to measure the expansion. The apparatus was tested on 999.6% pure Ag. The results, at 20° C intervals, are shown in tabular and graphical forms, and interpolation formulae are given. The theoretical relationship between α/C_V and C_V of the form $\alpha/C_V = A_0 + A_1\int_0^T C_V dT$, where α and C_V are the thermal expansion coefficient and specific heat at constant volume respectively, is derived and it is shown that the experimental results give $(\alpha/C_V)10^6 = 5.28 + 0.160\,U/\Theta$ and $5.22 + 0.147\,U/\Theta$ for KCl and KBr respectively, where U is the internal energy, and Θ is the Debye characteristic temperature equal to 230 and 177° K respectively

S.Weintroub

539.2 : 536.41

15816 THERMAL EXPANSION OF DIAMOND BETWEEN 25° AND 750° K. S.I.Novikova.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1617-18 (July, 1960). In Russian.

The linear thermal expansion coefficient (α) of diamond fell monotonically with temperature, approaching zero at $T \cong 90^\circ$K. Below 90° K, the value of α was very small and negative (-2 to -3×10^{-7} deg^{-1}); no minimum was observed.

A.Tybulewicz

539.2

• 15817 THERMAL EXPANSION OF DELTA AND EPSILON ZIRCONIUM HYDRIDES.

C.P.Kempter, R.O.Elliott and K.A.Gschneidner, Jr.

J. chem. Phys., Vol. 33, No. 3, 837-40 (Sept., 1960).

The thermal expansion characteristics of polycrystalline delta (face-centred-cubic) zirconium hydride and epsilon (body-centred-tetragonal) zirconium hydride were determined between room temperature and 362° C and 300° C, respectively, by means of X-ray diffraction techniques. The average linear thermal expansion coefficient for the delta phase is $2.98 \times 10^{-6}/^\circ$C for the range 24° to 362° C. For the epsilon phase, the average coefficients for the range 24° to 300° C are $-1.4 \times 10^{-6}/^\circ$C and $30.6 \times 10^{-6}/^\circ$C for the a and c directions, respectively, and $9.3 \times 10^{-6}/^\circ$C for the randomly oriented polycrystalline material.

539.2

15818 SOME REMARKS ON LATTICE THERMAL CONDUCTIVITY. D.K.C.MacDonald.

Amer. J. Phys., Vol. 28, No. 6, 551-6 (Sept., 1960).

The problem of lattice thermal conductivity (in an insulator) has been outstanding for many years. Debye and Peierls made fundamental contributions in relating finite thermal conductivity to anharmonic interactions between the normal modes of lattice vibration; detailed analysis and calculation, however, remains today a difficult problem. This paper presents a rather crude and elementary discussion of the problem for "classical" temperatures ($T >\sim \theta$) which yields a semiquantitative result in agreement with other workers. A reasonably direct estimate of the probable magnitude of the contribution to the thermal resistivity which arises from the quartic term in the lattice potential is also made.

539.2

15819 THE THERMAL CONDUCTIVITY OF SOLID SOLUTIONS OF SEMICONDUCTORS. A.V.Ioffe and A.F.Ioffe.

Fiz. tverdogo Tela, Vol. 2, No. 5, 781-92 (May, 1960). In Russian.

Results are given for many mixtures, such as ZnSe—CdTe, HgSe—HgTe, etc. at 280° K for compositions from 0 to 100%. The thermal resistivity K, is divided into two parts; (1) $K_0 = K_1c + K_2(1-c)$ where K_1 and K_2 are the resistivities of the pure components, and (2) $K - K_0$. For some mixtures $K - K_0 \propto c(1-c)$ and in some it is asymmetrical with respect to c and fits the relationship $K - K_0 = S_2c^2(1-c) + S_1c(1-c)^2$. The cross-sections for scattering of phonons are derived.

R.Berman

539.2

15820 THE THEORY OF PHONON THERMAL CONDUCTIVITY OF IMPERFECT CRYSTALS NEAR THE CRITICAL POINT ON THE DECAY CURVE OR A SECOND-ORDER PHASE TRANSITION. M.A.Krivoglaz.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1200-10 (June, 1960). In Russian.

At low temperatures heat is conducted by long-wave phonons for which long-range correlation is important. The effects of anharmonicity are neglected and it is assumed that perturbation theory can be used, with the mean free paths considerably greater than the wavelength. The relation $\kappa \propto T$ is derived for solid solutions quenched from near the critical point and the conductivity κ eventually passes through a minimum. As the composition approaches that of the critical state, the temperature of the minimum and the absolute value of κ decrease. For stoichiometric solutions there is a sharp rise in κ at the transition to the ordered state. It is mentioned that in ferroelectrics near the second-order phase transition at low temperatures, optical modes and excitons may conduct heat. Even at 0.01Θ all the transverse optical modes may contribute, but the mean free path may be small. R.Berman

539.2 : 536.2

15821 THE EFFECT OF A MAGNETIC FIELD ON THE THERMAL CONDUCTIVITY OF INDIUM ANTIMONIDE.

D.Kh.Amirkhanova and R.I.Bashirov.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1597-1607 (July, 1960). In Russian.

Investigated at 20-500° K. The results are explained using the magnetothermal resistance (Maggi—Righi—Leduc) effect theory for strong magnetic fields. The temperature dependence of thermal conductivity of InSb was studied between 20° and 700° K; in this region the lattice conductivity was proportional to the reciprocal of the absolute temperature. A.Tybulewicz

539.2

15822 THERMAL CONDUCTIVITY OF EIGHT HALIDE CRYSTALS IN THE TEMPERATURE RANGE 220°K TO 390°K.

K.A.McCarthy and S.S.Ballard.

J. appl. Phys., Vol. 31, No 8, 1410-12 (Aug , 1960)

The thermal conductivity of eight halide crystals has been measured over the temperature range 220°K to 390°K. The thermal conductivities of potassium bromide, potassium chloride, and sodium chloride vary inversely with temperature for the lower part of this temperature range, and are nearly independent of temperature for the higher temperatures of the range measured. The thermal conductivities of cesium bromide, cesium iodide, and silver chloride are nearly independent of temperature throughout the entire temperature range. The thermal conductivities of barium fluoride and calcium fluoride vary more rapidly with temperature than anticipated from a T^{-1} relationship; however, the accuracy of the data is not sufficient to establish the exact form of the variation of the thermal conductivity with temperature. The comparative method used for these measurements is described.

539.2 : 536.2

15823 PHONON [PART OF THE] TRANSVERSE THERMOMAGNETIC NERNST EFFECT IN P-TYPE GERMANIUM.

Yu. N. Obraztsov, I.V Mochan and T.V.Smirnova.

Fiz. tverdogo Tela, Vol. 2, No. 5, 830-5 (May, 1960).. In Russian.

Dependence of the phonon part of the Nernst constant on the magnetic field intensity was calculated for p-type germanium allowing for transitions between light- and heavy-hole bands. This dependence was measured in a number of samples. The results of measurements agree satisfactorily with theory. A.Tybulewicz

539.2

15824 THE ROLE OF TWO-PHONON PROCESSES IN SCATTERING OF CONDUCTION ELECTRONS IN IONIC CRYSTALS.

I.G.Lang.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 186-91 (1959). In Russian.

Discusses two-phonon scattering of conduction electrons on the optical vibrations in ionic crystals at temperatures much higher than the characteristic (Debye) temperature of the crystal. First-order perturbation theory was used to calculate scattering on the perturbation potential, which was a quadratic function of the ion displacements. It was found that the mobility, governed by the processes discussed here, is proportional to $T^{-5/2}$ and includes a constant which depends on the form of the electron wave-function. A.Tybulewicz

539.2

15825 INFLUENCE OF THE EXCHANGE AND CORRELATION ON THE ELECTRON—PHONON INTERACTION IN METALS.

T.Toya.

Progr. theor. Phys., Vol. 20, No. 6, 971-2 (Dec., 1958).

Bardeen and Pines concluded that exchange and correlation have negligible effect on the phonon dispersion relation and on the effective matrix element $V_p(q)$ for electron—phonon interaction. This conclusion is questioned and a modified expression for $V_p(q)$ is given. A calculation of the compressibility of Na on this basis leads to excellent agreement with experiment. D.M.Edwar

539.2 : 53

15826 ELECTRICAL CONDUCTIVITY OF MONOVALENT METALS.

T.Toya.

Progr. theor. Phys., Vol. 20, No. 6, 973-4 (Dec., 1958).

The electron—phonon interaction constants of Li, Na, K, Rb, C Cu are evaluated using $V_p(q)$ (see previous abstract) and compared with values deduced from conductivity data. The agreement is ver much improved over that obtained in the Hartree approximation. D.M.Edwar

539.

15827 NORMAL VIBRATIONS OF COPPER.

T.Toya.

Progr. theor. Phys., Vol. 20, No. 6, 974-6 (Dec., 1958).

The phonon dispersion relation $\omega(q)$, modified to include exchange and correlation effects (see preceding abstracts), is given explicitly. Curves are plotted for Cu in the (1,0,0), (1,1,0) and (1,1,1) directions and compared with Jacobsen's results obtain from X-ray scattering experiments (Abstr. 3258 of 1955). The elastic constants c_{11}, c_{44} and $c_{11} - c_{12}$ are estimated to be respectively 14.0, 8.2 and 4.6 in units of 10^{11} dynes/cm². D.M.Edwar

539.2 : 539.

15828 ON THE NUMBER OF 3d-ELECTRONS IN THE TRANSITION METALS.

F.M.Gal'perin.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 4, 801-2 (June 1, 1960). In Russian.

The relationship between the crystal lattice structure and the full number, n_d, of 3d-electrons in a transition metal atom was shown to be described by

$$n_d = N - [(\tfrac{1}{2}Z - \omega\pi^2\nu^2)^2 + p]$$

where N is the maximum possible number of 3d-electrons with two spin directions, Z is the atomic number of the element, $\omega\pi^2\nu^2$ is a coefficient, calculated by Dyson (Abstr. 5998 of 1956), and p is a numerical coefficient. The magnitude of N, $\omega\pi^2\nu^2$, and p depend on the type of the crystal lattice and lattice parameters. The calculat values of n_d were in close agreement with the experimental data, quoted in the literature, and indicated that $n_d = 0$ for Sc, Ti, and V M.H.Slobod

539.

15829 A STATISTICAL THEORY OF THE KINETIC COEFFICIENTS OF A CRYSTAL WITH A STRONGLY DEGENERATE ELECTRON GAS.

M.I.Klinger.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 136-42 (1959). In Russian.

Gives expressions for the electrical conductivity, the electron part of thermal conductivity and the thermoelectric power, obtaine for the case of a strongly degenerate electron gas, assuming weak electron—phonon interaction. Shows that the electronic part of thermal conductivity and thermoelectric power are second-order effects. Establishes a criterion of the smallness of the contributio of virtual transitions to the kinetic coefficients in the case of stron degeneracy. A.Tybulewic

539.2 : 539.1

POSITRON ANNIHILATION IN SULPHUR AND ITS COMPOUN γ-RAY ANGULAR CORRELATION. See Abstr. 15336

539

15830 INFLUENCE OF BOUNDARY CONDITIONS ON THE ELECTRON DENSITY IN A PERIODIC LATTICE.

G.Leman.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 221-34 (June, 1960). In Fre

In a band structure, the electronic density varies with the boundary conditions, near the boundaries. This effect has been studied in detail on a Kronig and Penney model. The contribution from full bands is shown to decrease exponentially with distance r. as exp(−qr); a nearly full or nearly empty band contributes a term $(\sin \Delta k_B r)/r$, where Δk_B is the difference in wave number between the Fermi level and the nearest band limit: its electrons or positi holes behave as though they were free. The exact values of the parameter q depend on the bands considered and on the boundary conditions.

539.2

831 A POSSIBLE SIZE EFFECT ON THE PLASMA OSCILLATION OF ELECTRONS IN SOLIDS.

Ichikawa.

r. theor. Phys., Vol. 19, No. 5, 585-6 (May, 1958).

It is pointed out that for a finite crystal there is a minimum
e-number for plasma oscillation. It follows from the dispersion
tion that the lowest excitable plasma frequency is higher than
in an infinite crystal. It is estimated that the effect should only
bserved for a grain size less than 50 A, but preliminary experi-
ts by Watanabe on Al suggest that the effect occurs for larger
n size. D.M.Edwards

539.2 : 536.48

DISPERSION OF PLASMA FREQUENCIES AND SCREENED HANGE ENERGY IN THE SUPERCONDUCTING STATE.

Abstr. 14929

539.2

5832 SYMMETRY OF THE ENERGY BANDS OF AN ELECTRON WITH SPIN. V.I.Sheka.

. tverdogo Tela, Vol. 2, No. 6, 1211-19 (June, 1960). In Russian.

Group theory methods are used to discuss the structure of the
rgy bands of a Dirac electron in a crystal and the formulae ob-
ied are applied to zinc blende. A.Tybulewicz

539.2

15833 CALCULATION OF THE ENERGY SPECTRUM OF STRONGLY ANISOTROPIC CRYSTALS.

.Gubanov and A.D.Chevȳchelov.

. tverdogo Tela, Vol. 2, No. 7, 1379-89 (July, 1960). In Russian.

Gives a quantum-mechanical calculation of the electron energy
ctrum for two models of an anisotropic crystal. It is assumed
t along some crystallographic axes the motion of electrons is
ost free, while along other axes it is greatly impeded. The
thods of strong and weak coupling are used in the calculation. It
shown that the electron dispersion laws are different in crystals
he same symmetry but with different types of chemical binding.
A.Tybulewicz

539.2

15834 TEMPERATURE DEPENDENCE OF ENERGY LEVELS OF EXCITON IN Cu_2O. L'.Hrivnák.

ech. J. Phys., Vol. 10, No. 2, 160-1 (1960).

The energy of the exciton levels in Cu_2O is temperature depend-
and the author suggests that this is due to the temperature de-
dence of the optical vibration frequency. It is suggested that a
lationship of the form $\omega = \omega_0 (1 - \alpha T)$, where ω_0 is the optical
ration frequency at 0°K and T is the absolute temperature, would
count for the change when $\alpha = 5.85 \times 10^{-4}$. It is also shown that
s order of magnitude for α is compatible with a value obtained
m a simple analysis from first principles of the frequency of the
tical vibrations in KCl. I.Cooke

539.2

15835 FORMATION AND DECOMPOSITION OF MOTT EXCITONS. A.A.Lipnik.

z. tverdogo Tela, Sbornik [Supplement] I, 36-46 (1959). In Russian.

The probability of formation of a Mott exciton on acoustic
onons is calculated for a wide range of temperatures, starting
m very low ones. It is shown that the probability of formation
independent of the positions of the electron energy minima in
Brillouin zone. The number of excitons formed in 1 sec is found
a function of temperature and other parameters. The probabi-
y of decomposition of a Mott exciton is deduced from the proba-
lity of formation, and the exciton lifetime is obtained.
A.Tybulewicz

539.2 : 77

THE FORMATION OF EXCITONS IN AgBr BY THE PASSAGE F AN IONIZING PARTICLE.

See Abstr. 14861

539.2

15836 THE BAND STRUCTURE OF THE POLARON ENERGY SPECTRUM. Z.Ya.Evseev.

iz. tverdogo Tela, Vol. 2, No. 6, 1222-3 (June, 1960). In Russian.

Extends work by Giterman and Tolpȳgo (Abstr. 5471 of 1958),
king into account: (1) the dispersion of longitudinal optical mode
ibrations of the ions, and (2) the quadratic dependence on the wave-
ector in the Fourier expansion for the dipole moments at the
ttice sites under the action of the polaron field. For KCl and
Br the results are little changed, while for NaCl, where the
olaron radius is small, neither the previous nor the present
ethod of calculation is correct. R.Berman

Defect Properties

539.2

15837 LATTICE DEFECTS IN A COPPER-ALUMINUM ALLOY. M.S.Wechsler and R.H.Kernohan.

Acta metallurgica, Vol. 7, No. 9, 599-607 (Sept., 1959).

Static (at-temperature) resistivity measurements and measurements after air-cooling and water-quenching indicate an excess resistivity contribution at temperatures above 200°C in Cu—Al (15 at.% Al) single crystals. From the static measurements, the energy of formation of the configuration responsible for the excess resistivity is determined to be about 0.2 eV. Annealing experiments after quenching from 450°C were conducted, from which the activation energy for motion was evaluated. These experiments are correlated with a previous investigation of the effect of neutron irradiation on Cu—Al alloys, and a discussion is given in terms of short-range ordering and the annealing of lattice vacancies.

539.2

15838 DIRECT OBSERVATIONS OF DEFECTS IN QUENCHED GOLD. J.Silcox and P.B.Hirsch.

Phil. Mag.(Eighth Ser.), Vol. 4, 72-89 (Jan., 1959).

An electron microscope transmission study has been made of thin foils of gold produced by electro-polishing from quenched gold specimens. Thin gold sheet was quenched from a vertical tube furnace at 910° to 960°C into iced brine. Subsequent ageing treatment was carried out, for example for an hour at 100°C. Contrast effects were observed of geometrical shapes with sides parallel to [110] projections in the plane of the foil. Analysis of the shapes of the contrast in two different orientations shows that they arise from tetrahedra of stacking faults on (111) planes with $\frac{1}{6}[110]$ type stair-rod dislocations along the edges of the tetrahedron. A reaction is pointed out whereby the defect may arise from an equilateral triangle, with [110] edges, of stacking fault surrounded by a Frank sessile dislocation on a (111) plane. On the assumption that the triangles were formed by the disc-like condensation of vacancies, the size of the defects, about 350 A, and the density, about 5×10^{14} cm^{-3}, correspond to an initial vacancy concentration of 6×10^{-5}. The interaction of dislocations with the defects confirms the hypothesis of stacking fault tetrahedra. Finally the formation of the defects and their influence upon the physical properties of the crystal are discussed.

539.2

15839 THE OBSERVATION OF DISLOCATIONS IN THIN SINGLE CRYSTAL FILMS OF GOLD PREPARED BY EVAPORATION. D.W.Pashley.

Phil. Mag. (Eighth Ser.), Vol. 4, 324-35 (March, 1959).

An evaporation technique has been developed to allow thin (approx. 200 A thick) detached single crystal films of gold to be prepared. These films are very coherent and uniform in thickness. Dislocation lines are observed in these films with a density of 10^{10}-10^{11}/cm^2. The dislocations may be observed to move inside the electron microscope. A prominent feature of the movement is the occurrence of wide ribbons of stacking fault due to the splitting of a dislocation in to two partial dislocations. Cross-slip is observed also. Annealing of the films has produced some regular arrays of dislocations, including hexagonal networks and arrays at low angle boundaries. Small loops are also found in some of the films and are interpreted as dislocation loops resulting from the collapse of discs of vacancies.

539.2

15840 THE INTERACTION OF PARALLEL EDGE DISLOCATIONS WITH A SIMPLE TILT DISLOCATION WALL.

J.G.M.Li.

Acta metallurgica, Vol. 8, No. 5, 296-311 (May, 1960).

An elastic theory analysis of the interaction of a dislocation wall (tilt substructure boundary) with parallel approaching dislocations whose slip vectors are the same as those of the dislocations in the wall is reported. It is found that such a wall fully or partially pinned is a less effective barrier for the penetration of dislocations than a single pinned dislocation on the same slip plane as the approaching dislocation. Quantitative results for the equilibrium positions of the free dislocations in the wall and the forces exerted on the approaching dislocation in various cases are presented. Free dislocations in the wall usually reduce the resistance of the wall to the penetration of approaching dislocations. The interaction between a wall and a solute atom is found to be less than that between the single nearest dislocation with the same solute atom. It is suggested that the experimental evidence which leads to the concept of hardening by substructures of this kind needs further interpretation. The segregation of vacancies and solute atoms to the dislocations probably plays a more important role in the hardening effect than the appearance of substructure.

539.2

15841 EQUILIBRIUM SHAPE OF AN EDGE-DISLOCATION LOOP IN THE PRESENCE OF A SUPERSATURATION OF VACANCIES. G.Saada.
Acta metallurgica, Vol. 7, No. 6, 367-73 (June, 1959). In French.

The method used in this investigation is similar to that employed by Burton, Cabrera and Frank for the study of growth nuclei. It takes into account the fact that dislocations climb out of the slip plane with the aid of jogs. (Undissociated dislocations have been assumed). With reasonable energies of formation and interaction of these jogs, the shape of the loops is found to depend strongly on the crystalline structure at normal temperatures. At very high temperatures ($kT \cong 0.1$ eV) the shape of the loop approaches that of a circle. In all cases, the average radius of curvature is of the same order of magnitude as that found by Bardeen and Herring. In conclusion, the possibility for a dislocation loop to produce spirals is studied.

539.2

15842 THE BLOCKING OF DISLOCATIONS BY CAVITIES AND SMALL PRECIPITATE PARTICLES. P.Coulomb.
Acta metallurgica, Vol. 7, No. 8, 556-9 (Aug., 1959). In French.

A crystal is considered in which the dislocations are blocked by a ring of small cavities. The influence of thermal agitation and applied stresses on the liberation of the blocked dislocations from the cavities is studied in detail. It is shown that the heat of activation of the phenomenon varies linearly with the applied stress in a manner similar to that which has already been proposed by the author. The yield stress σ is given, at 0° K, by the Frank—Read relationship $\sigma = \mu b/l$. Here μ is elastic constant, b is the Burger's vector, and l the distance between voids along a dislocation. The ratio σ/μ has to decrease linearly with increasing temperature. The slope of this curve is negligible when the diameter of the cavity is larger than several Burger's vectors. The same analysis is applied to the blocking of dislocations by rings of small precipitate particles.

539.2

15843 DISLOCATIONS IN LAYER STRUCTURES. V.A.Phillips and P.Cannon.
Nature (London), Vol. 187, 313-14 (July 23, 1960).

Describes electron-microscope observations of dislocations in molybdenite sheets 1μ thick, and of moire fringes and dislocations in graphite sheets. A.R.Stokes

539.2

15844 THE POSITIONS OF DISLOCATIONS IN ARRAYS. A.K.Head.
Phil. Mag. (Eighth Ser.), Vol. 4, 295-302 (March, 1959).

The equilibrium positions of dislocations in a number of types of array have been found numerically. Arrays considered are: (i) that generated by a dislocation source which is between two locked dislocations, (ii) a dislocation pile-up against a locked dislocation which is not on the slip-plane, (iii) a group of positive dislocations attracted to a group of negative dislocations but prevented from coalescing by locked dislocations, (iv) a group of positive dislocations attracted by a group of negative dislocations on a parallel slip plane. A short table of the zeros of the first derivative of the Laguerre polynomials is given.

539.2

15845 THE ANGULAR DISLOCATION. E.H.Yoffe.
Phil. Mag. (Eighth Ser.), Vol. 5, 161-75 (Feb., 1960).

The stress field of a sharply angular dislocation is calculated by Burgers' method. It is shown that more complicated configurations may be composed of angular dislocations, and the corresponding stress fields deduced by adding the fields of the components. Some examples are given, including the triangle, hexagon and tetrahedron.

539.2

15846 POSSIBILITY OF THE EXISTENCE OF ATTRACTIVE FORCES BETWEEN DISLOCATIONS OF LIKE SIGN. J.Weertman.
Phys. Rev., Vol. 119, No. 6, 1871-2 (Sept. 15, 1960).

It is concluded that two moving dislocations of the same sign and on the same slip plane can sometimes attract rather than repel one another (and two of unlike sign repel rather than attract each other). This reversal over the usual behaviour will occur at velocities where the kinetic energy in the displacement field of an isolated moving dislocation is larger than the strain energy in the sam field.

539.

15847 SOME PROPERTIES OF CRYSTALS OF SILVER CHLORIDE CONTAINING TRACES OF COPPER CHLORIDES. A.S.Parasnis and J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 4, 171-9 (Feb., 1959).

A number of properties of crystals of silver chloride containin traces of copper chlorides have been investigated with the microscope. It has been found that the dislocations remaining after annealing in crystals which contained originally 0.1 mole % of cupric chloride are decorated by the separation of a second phase during cooling. Crystals containing cuprous chloride have a high photosensitivity but the products of photochemical change fade on storag Valuable observations have been made on arrays of dislocations in well annealed and recrystallized specimens and on dislocations int duced by plastic deformation. With these crystals it has been poss to demonstrate that the space required for the separation of furthe silver atoms upon a silver particle inside the crystal is made available by the formation of prismatic dislocation loops which glid away from the interface between the particle and the surrounding crystal. This is a new phenomenon in the physics of the solid state which has not been previously described.

539.

15848 THE FLOW STRESS OF IRON AND ITS DEPENDENCE ON IMPURITIES. G.Schoeck and A.Seeger.
Acta metallurgica, Vol. 7, No. 7, 469-77 (July, 1959).

In the stress field of a dislocation an ordering of solute interstitials takes place. By this Snoek-effect dislocations are locked in times which are too short to allow the formation of Cottrell atmo spheres. The locking energy and the stress to free the dislocation is calculated for a screw dislocation in α-iron. If the dislocation moves, a frictional force is caused by the Snoek-effect and its magnitude is calculated. It is suggested that this mechanism determine the flow stress of α-iron above room temperature and experimenta results are discussed which support this point of view.

539

15849 THE NATURE OF THE INTERCRYSTALLINE TRANSITION ZONES IN METALLIC [ALLOY] POLYCRYSTALS. G.I.Aksenov and A.I.Sidnikhin.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 156-8 (1960). In Russian.

It is postulated that the changes, occurring at high temperatur at the grain boundaries of a single-phase polycrystalline alloy, are associated with the movement of dislocations to the grain boundari As the dislocation density increases, the grain boundary region ma grow at the expense of the adjacent crystals and, in the case of a solid solution become enriched in the solute atoms by formation of "atmospheres" around dislocations. Consequently, even a slight plastic deformation should result in redistribution of dislocations and radically change the conditions at the grain boundaries. This view was confirmed by the results of metallographic analysis and determination of the rate of chemical dissolution of the EI437B alloy, subjected to various mechanical and thermal treatments. M.H.Slobod

539

15850 THE KINETICS OF THE FIRST STAGE OF TEMPERING. M.Hillert.
Acta metallurgica, Vol. 7, No. 10, 653-8 (Oct., 1959).

The methods are discussed of evaluating from experimental data the activation energy of a process and the exponent in the kine equations. The value of the exponent is subject to considerable uncertainty, being very sensitive to the choice of impingement factor and to a variation of the activation energy. The kinetics of the firs stage of tempering of martensite is accounted for in terms of ordir ary diffusion without using the dislocation-attraction model. The diffusion coefficient of carbon in martensite is derived theoreticall and an exponential variation with carbon content is found, explainin the discontinuous character of the first stage of tempering.

539.2

51 SOLUTION HARDENING BY INTERACTION OF IMPURITY GRADIENTS AND DISLOCATIONS.

leischer.

metallurgica, Vol. 8, No. 1, 32-5 (Jan., 1960).

he Cottrell interaction (1953) between dislocations and impurity may give rise to significant interaction stresses when the ity concentration is not uniform.

539.2

852 QUENCH HARDENING IN SODIUM CHLORIDE CRYSTALS.

B.H.Kear and P.L.Pratt.

Mag. (Eighth Ser.), Vol. 4, 56-71 (Jan., 1959).

The quench-hardening of sodium chloride has been studied, ally and mechanically, after various quenching treatments. e experiments suggest that, in addition to quenching strains, ardening is due to the pinning of dislocations by impurities and associated vacancies retained in solid solution, and, after fast ches from close to the melting-point, to the additional difficulties oving dislocations through a fine dispersion of vacancy clusters. her evidence for these two hardening mechanisms is obtained recovery experiments.

539.2

5853 ENERGY AND ELECTRICAL RESISTIVITY OF HIGH-ANGLE GRAIN BOUNDARIES IN METALS.

eger and G.Schottky.

metallurgica, Vol. 7, No. 7, 495-503 (July, 1959). In German.

Electron theory of metals is employed to calculate the energy the electrical resistivity for a simple model of high-angle grain daries. The basic idea is this: At the grain boundary the age distance between atoms is somewhat larger than in the ideal tal. The displaced positive charge of the atom cores has to be ened by a redistribution of the conduction electrons. The increase in energy due to this redistribution is calculated for a gas uasi-free electrons. For silver and copper surprisingly good eement with measurements of grain boundary energies is found. m this it is concluded that the model accounts for the main ribution to the energy of high-angle grain boundaries in metals. same model is used to calculate the electrical resistivity of a in boundary and to estimate the ratio between increase in resisty and relative change in crystal density. This ratio turns out to somewhat smaller than that for vacancies and interstitials.

539.2

15854 GEOMETRY AND KINETICS OF THE POLYGONIZATION OF SODIUM CHLORIDE. S.Amelinckx and R.Strumane.

a metallurgica, Vol. 18, No. 5, 312-20 (May, 1960).

The geometry and kinetics of the domain growth during polyization of sodium chloride is studied. It is found that the breaking of ending walls is the dominating process in the initial stages, ilst the Y-shaped junctions dominate the growth processes in final stages. The interaction between growth in sub-boundaries the newly formed polygon walls is also considered. The interion of isolated edge dislocations with a wall of edge dislocations discussed in some detail. The kinetics of the polygonization cess was studied by means of isothermal annealing curves. o different activation energies are found: one for the low tempeure range (49 kcal/mol) and one for temperatures above 375°C kcal/mol). The difference between these two activation energies interpreted as the activation energy for jog formation; its value 0.6-0.8 eV.

539.2

15855 DISLOCATION AND DIFFUSION PHENOMENA IN RECRYSTALLIZATION OF DEFORMED COPPER.

Ya. Pines, É.F.Chaikovskii and N.V.Kaluzhinova.

z tverdogo Tela, Sbornik [Supplement] II, 264-72 (1959). In ssian.

X-ray diffraction micro-beam methods were used to study the netics of the growth of blocks and grains during isothermal annealg of compression-deformed copper. In the initial stage of lowmperature annealing, discontinuous rises of block dimensions ere observed which were due to displacement of dislocations lock boundaries were formed from vertical series of dislocaons). At high temperatures block and grain growth occurred rough self-diffusion.

A.Tybulewicz

539.2

15856 THE ELIMINATION OF VACANCIES IN HIGH-PURITY ALUMINIUM. M.Wintenberger.

cta metallurgica, Vol. 7, No. 8, 549-55 (Aug., 1959). In French.

In high-purity aluminium, air-cooled from elevated temperatures, the resistivity increment due to vacancies is completely eliminated at room temperature. The rate of this recovery increases with the dislocation density. It is supposed that dislocations remove all the vacancies by a process of elastic interaction. It is possible, after having determined the energy of diffusion of vacancies, to evaluate the dislocation density produced by cold-working. The influence on the electrical resistivity of dislocations and vacancies created by plastic deformation is also studied. At high quenching rates the vacancies are eliminated by the formation of other crystal defects possessing a high resistivity.

539.2

15857 KINETICS OF THE PHOTOCHEMICAL TRANSFORMATION OF F-CENTRES INTO F_2-CENTRES IN ALKALI HALIDE CRYSTALS.

K.B.Tolpȳgo, Yu.A.Tsvirko and A.A Shatalov.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 170-9 (1959). In Russian.

Gives a theoretical discussion of transformation of F-centres into F_2-centres by light. It is assumed that F-centres are photoionized, producing halogen vacancies (F^+) and polarons, and then F'-centres and F_2^+-centres. Next, as the result of the joining up of F_2'-centres and F^+-centres, or F_2^+-centres and polarons, F_2-centres are formed. Time dependences of exponential, hyperbolic and other types are obtained for densities of F- and F_2-centres. Experimental studies of the course of the transformation are discussed.

A.Tybulewicz

539.2

15858 THE ENERGY SPECTRUM OF AN F-CENTRE IN THE CONTINUUM THEORY. Yu. E.Perlin.

Optika i Spektrosk., Vol. 8, No. 3, 386-93 (March, 1960). In Russian.

Within the framework of the continuum theory of an F-centre, two types of variational function are compared. It is shown that functions of the first type (hydrogen-like model) give better results in calculation of the ground-state energy. For all the excited states, functions of the second type (polaron model) yield more exact values of the energies. This indicates that in the theory of the excited states of an F-centre and other impurity centres in ionic crystals it is necessary to allow for the collective motion of phonons caused by the "excess" electrons (polaron effect).

A.Tybulewicz

539.2

15859 THE PHOTO CREATION AND DESTRUCTION OF F CENTRES. R.V.Hesketh.

Phil. Mag. (Eighth Ser.), Vol. 4, 114-25 (Jan., 1959).

F centres formed within, and not at external surfaces of KCl crystals have been observed. The rate of creation by X-rays has been found to be of the form $dN/dt = A - BN$, where A and B are temperature dependent constants. The constant A has been found to be close to the rate of liberation of electrons multiplied by an energy factor $\exp(-0.05\ \text{eV}/kT)$. It is suggested the F centres are formed from electrons trapped at incipient negative ion vacancies. Optical bleaching shows that the thermal activation process from the excited state to the conduction band is similar to that in additively coloured crystals. The quantum efficiency of bleaching indicates that less than 10^{15} per cm^3 of frozen-in vacancies take part in colour centre formation and that at 300°K the created vacancies are only stable when occupied by electrons.

539.2

15860 AN INVESTIGATION ON THE N- AND O-COLOUR CENTRES IN THE CRYSTALLINE PHOSPHOR KCl:Tl.

P.A.Khellenurme.

Optika i Spektrosk., Vol. 8, No. 5, 729-31 (May, 1960). In Russian.

The phosphors were excited at 180°K by means of 196 mμ radiation, and were then illuminated with linearly polarized light of 825 mμ wavelength (the M-band) incident at right-angles to the (100) plane. An optical flash produced in this way was recorded at 180°K and showed the presence of dichroism. Dichroism was observed also on illumination with polarized light of $\lambda = 560$ mμ (the F-band), 1120 mμ (the N-band) and 1530 mμ (the O-band). In all these cases dichroism was observed not only in the band which was stimulated, but in the other three bands as well. This indicates that the relevant centres are anisotropic. Additional experiments showed that dichroism of a given centre was affected by the presence of other centres (migration of energy was possible between neighbouring F-, M-, N-, and O-centres).

A.Tybulewicz

539.2

15861 RELATION BETWEEN X-RAY COLORATION AND OPTICAL BLEACHING OF KCl CRYSTALS. W.E.Bron.

Phys. Rev., Vol. 119, No. 6, 1853-63 (Sept. 15, 1960).

Changes in the absorption of KCl crystals in the spectral region of 200 and 1000 mμ were observed during room temperature X-ray irradiation and subsequent bleaching with F-light. It is observed that both coloration and bleaching of the F-band occurs in two stages. Secondary centres such as M, R, and V_s centres grow primarily during the second stage of coloration, and the rate of growth of these centres during the second stage is enhanced by plastic deformation in a manner similar to that of the F-band. It is found that the absorption change at the F-band during the first stage of bleaching approximately equals that during the first stage of coloration. Furthermore, the initial rate of bleaching of the F-band is proportional to the initial F-band absorption in samples irradiated only into the first stage of coloration, but is essentially independent of the initial F-band absorption in samples irradiated into the second stage of coloration. It is concluded from this and other evidence that the centre responsible for the first stages of coloration and bleaching differs from the centre responsible for the second stages of coloration and bleaching. A major point of difference is that the first stage centres are considered to be located in the bulk of the crystal, whereas the second stage centres are located in the vicinity of dislocations. It is also observed that M-centres which are formed from F-centres during the first stage of bleaching can be bleached with F-light. To explain the observations concerning this M-band bleaching, it is porposed that M as well as F-centres are bleached when they are joined by mobile defects, possibly vacancy pairs. Some of the second stage centres located in the vicinity of dislocations are thought to compete with the centres located in the bulk of the crystal for the mobile defects. See also following abstract.

539.2

15862 DEPENDENCE OF THE OPTICAL BLEACHING RATE OF X-IRRADIATED KCl CRYSTALS ON LIGHT INTENSITY. W.E.Bron and W.R.Heller.

Phys. Rev., Vol. 119, No. 6, 1864-8 (Sept. 15, 1960).

Measurements were made on the changes in the bleaching rate of the F-band as the result of varying the intensity of F-light. Bleaching was done on KCl crystals which had been irradiated at room temperature with hard X-rays into either the first or second stage of coloration. In the first stage irradiated crystals the total bleaching of the F-centres during the first 10 sec of illumination varied approximately linearly with light intensity at low intensities, but becomes saturated at intensities greater than 5×10^{14} photons/sec cm^2. The bleaching process is thought to occur primarily through the capture of photoelectrons at pre-existing electron traps. Based on this model it is possible to set up the kinetic equations for the bleaching process. Using reasonable values for photoelectron capture coefficients forces one to conclude that the number of photoelectrons is always very small throughout the bleaching process. The resulting simplification in the analysis of the kinetic equations leads to a prediction of the experimentally observed variation of the initial bleaching rate with light intensity. The analysis shows that the ratio of the capture coefficient for photoelectrons of the electron trapping centres to that of negative-ion vacancies is about unity, which strongly suggests that the trapping centres are either traps with net positive charge or are neutral traps located close to the original F-centres. The rate of bleaching during the second stage of bleaching saturated at the lowest intensity used which was about 1×10^{14} photons/sec cm^2. This result is discussed in terms of the analysis given for the first stage of bleaching.

539.2

15863 THE EFFECT OF ANNEALING ON THE STATE OF SOME IMPURITIES IN GERMANIUM.

V.E.Lashkarev, E.G.Miselyuk and K.D.Glinchuk.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 114-121 (1959).

In Russian.

Reports a study of the effect of 400-600°C annealing of germanium, alloyed with iron, nickel and cobalt, on the density of the equilibrium carriers (deduced from the Hall effect) and on the lifetime of non-equilibrium carriers in the interior of germanium. Annealing produced "deactivation" of impurities, i.e. disappearance of the properties characterizing the presence of iron, nickel and cobalt in germanium. The results are in good agreement with the hypothesis that the process of "deactivation" consists of precipitation of the impurities from the solid solution. A.Tybulewicz

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15864 THE TEMPERATURE DEPENDENCE OF THE ENER OF IONIZATION OF IMPURITY CENTRES IN A COVALENT CRYSTAL. I.Z.Fisher and Ch.K.Smolik.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 3-7 (1959). In Russia

Deduces the following formula for the ionization energy ΔE valid at not too high temperatures:

$$\Delta E = \Delta E_0 - 2\gamma kT,$$

where $\gamma \cong 0.15\ \Delta E_0/kT_{mp}$, k is Boltzmann's constant, T the abs lute temperature and T_{mp} the melting point of a covalent crystal. A.Tybulewi

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15865 SUBSTITUTIONAL AND INTERSTITIAL ALUMINUM IMPURITY IN QUARTZ, STRUCTURE AND COLOR CENTER INTERRELATIONSHIPS. A.J.Cohen.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 321-5 (June, 1960).

That colour centres in the 460 and 625 mμ regions of the qua spectrum are related to substitutional aluminium impurity is now well established. Indirect evidence has indicated that interstitial aluminium may appear in quartz. Buerger has discussed the stuff of quartz by β-eucryptite, $LiAlSiO_4$, with cell dimensions a little more than double those of β-quartz. Recently, other workers hav found that β-spodumene, $LiAl(SiO_3)_2$, is also isomorphous with β-quartz. Synthetic quartz grown from a Z-seed was found to cor tain in ppm Si atoms: 290 Al; 260 Li; 8 Fe; and 131 Na. X-irrad tion for long periods gave no change in the optical absorption of t quartz down to 1850 A. It was concluded that the aluminium prese was interstitial. An attempt to precipitate the interstitial alumin and lithium was successful. This separate phase was found to "decorate" the macromosaics and to indicate the manner of growt of synthetic quartz on various seed orientations. Small regions o rhombohedral growth on the Z-seed crystals did colour due to the substitutional aluminium content. There was no precipitation of in stitial aluminum in these regions. The increase of the spin-lattic relaxation time of the Si^{29} nucleus after precipitation indicates th the paramagnetic trace impurity in Z-seed crystals is also interstitial. Precipitation experiments on Y-bar synthetic quartz coup with X-irradiation indicate that the trace of aluminium present in the Z-zones is interstitial and that the major portion of the alumi in the X(fast) zone is substitutional, while the aluminium in the X(slow) zone is both substitutional and interstitial. The colour banding in X-rayed Y-bar crystals is discussed as well as the dependence of the intensity of the smoky colour (due to the alumin colour centre system) on the crystallographic orientation of the growing zone and how this can be used to identify the different vic faces and their "birth" during growth of the crystal. Mention is made of the effects of germanium (IV) ion on the substitutional aluminium content of the Z-zones.

53

15866 THE DIFFUSION OF CARBON DURING PRECIPITAT IN α-IRON. R.H.Doremus

Acta metallurgica, Vol. 7, No. 7, 399-402 (June, 1959).

The activation energy for precipitation of carbon from α-iro was measured to be 17.1 ± 0.5 kcal/mole by starting the precipitation at one temperature and finishing it at another. The activation energy was the same within experimental error for aging temperatures from 0° to 170°C, for samples strained up to 4 per cent, and for samples of different concentration. This energy is appreciably smaller than that of 20.1 kcal/mole for carbon diffusi in α-iron measured from elastic relaxation methods. Possible reasons for this difference are discussed, but no satisfactory explanation for it is found.

53

15867 A CORRELATION OF DATA ON DIFFUSION OF SOLU IN FACE-CENTERED CUBIC METALS.

D.Turnbull and R.E.Hoffman.

Acta metallurgica, Vol. 7, No. 6, 407-10 (June, 1959).

It is shown that the available data on the diffusion coefficient of substitutional solutes B in dilute face-centred cubic solutions i A can be described approximately by the equation:

$$\Delta F'_B - \Delta F'_A = \frac{Q_A}{4}\,\frac{U_A - U_B - \overline{\Delta U}_{AB}}{U_A}$$

$\Delta F'_B$ and $\Delta F'_A$ are the free energies of activation for solute and solvent diffusion at the melting point of the pure solvent; Q_A is th tion energy for self-diffusion in pure A; U_A and U_B are the ve energies of pure A and pure B respectively and $\overline{\Delta U_{AB}}$ is at of solution of B in A. This correlation, though not in strict d with the nearest neighbour model for solutions, was suggested

539.2

368 **THE DIFFUSION OF XENON IN SILVER.** J.M.Tobin.

netallurgica, Vol. 7, No. 11, 701-5 (Nov., 1959).

iffusion coefficients were determined at temperatures of 500°, 700°, 735° and 800° C. The activation energy for diffusion is cal/g atom. The diffusion coefficients can be represented equation:

$$D_{Xe} = 0.036 \exp(-37\,500/RT) \text{ cm}^2/\text{sec}.$$

iffusion of xenon in silver is attributed to the mobility of ve xenon ions from substitutional sites in the lattice to vacant ent sites.

539.2 : 539.3

5869 **THE EFFECT OF PLASTIC DEFORMATION ON THE DIFFUSION OF HYDROGEN IN NICKEL.** H.H.Grimes.

metallurgica, Vol. 7, No. 12, 782-6 (Dec., 1959).

The diffusion of hydrogen in elastically and plastically strained l has been measured by a permeability experiment with the lt that no significant change of the diffusion coefficient was observed for deformations up to 10%. These results are in agreement a recent theoretical analysis of interstitial diffusion in strained ems based upon considerations of interatomic forces and strain ients. The diffusion coefficient calculated for hydrogen through rained nickel can be represented by the equation:

$$D = 0.0095 \exp(-10\,300/RT) \text{ cm}^2/\text{sec}$$

e temperature interval 430°-850° C.

539.2

5870 **THE EFFECT OF AN ELECTRIC FIELD ON THE DIFFUSION OF SILVER IN GERMANIUM.**

Kosenko, E.G.Miselyuk and L.A.Khomenko.

tverdogo Tela, Sbornik [Supplement] I, 100-3 (1959). In Russian.

Using Ag^{110} as a tracer, the sign and the mean magnitude of the ge of silver ions diffusing in germanium at 760-870° C were d to be: +1 ± 0.2. A.Tybulewicz

539.2

15871 **BOUNDS ON THE NONLINEAR DIFFUSION CONTROLLED GROWTH RATE OF SPHERICAL ECIPITATES.** J.A Morrison and H.L.Frisch.

ppl. Phys., Vol. 31, No. 9, 1621-7 (Sept., 1960).

Considers a nonlinear diffusion problem in which there is a nge of phase. The physical situation is e.g., the diffusion of ute in a crystal towards a growing precipitate. The nonlinear- usion coefficient is a function of the local concentration of solute. adially symmetric precipitate which grows at a rate propor- al to the square root of the time is considered in n dimensions = 1, 2, 3); thus $\rho = s(D_0 t)^{1/2}$ where ρ is the radius, D_0 is a constant ing dimensions of area/time and s is a number, the quantity of ticular interest. A comparison theorem is established which, in t, states that s increases with increasing diffusion coefficient. A sequence of the theorem is that a unique value of s is associated h a prescribed diffusion coefficient. The comparison theorem also ds to bounds on s. Some other bounds, involving functionals of diffusion coefficient, are also obtained for s.

539.2

15872 **DIFFUSION IN A LINEAR LATTICE.** I.W.Plesner.

chem. Phys., Vol. 33, No. 3, 652-62 (Sept., 1960).

Diffusion in crystals by a vacancy mechanism is described by a odel consisting of an isotope and a vacancy imbedded in a linear tice of harmonic oscillators. Assuming a 6-12 potential between fects and lattice atoms, the anharmonic interaction is explicitly lculated. The unusual approximation of assuming this interaction depend linearly on the frequency is shown to be valid as long as Debye approximation for the frequency spectrum is applicable. e lattice width defects is analysed using the formalism developed by out and Prigogine (Abstr. 121 of 1957). In order to solve the uations, the concept of localized modes is introduced. The calized mode is approximated by the oscillation of the defect (isotope) in the lattice. The justification for this is investigated by a method due to Montroll and Potts (Abstr. 792 of 1956). The diffusion constant is calculated and shown to depend on the fourth power of the defect frequency. This is in agreement with an earlier result by Klemens, but deviates appreciably from the usual first power dependence.

539.2

15873 **OXYGEN DIFFUSION IN PERICLASE CRYSTALS.** Y.Oishi and W.D.Kingery.

J. chem. Phys., Vol. 33, No. 3, 905-6 (Sept., 1960).

Oxygen self-diffusion coefficients were determined for MgO crystals over the temperature range 1300-1750° C. Results can be represented by the equation $D = 2.5 \times 10^{-6} \exp(-62\,400/RT)$. By comparison with data for alkali halides and previous measurements for aluminium oxide, diffusion is probably extrinsic in nature. The diffusion coefficient for oxygen in this material is about two orders of magnitude less than that reported in the literature for magnesium.

539.2

15874 **DIFFUSION OF Xe^{133}, Rn^{222} AND I^{131} IN THORIUM OXIDE.** H.Matzke and R.Lindner.

Z. Naturforsch., Vol. 15a, No. 7, 647-8 (July, 1960). In German.

The rate of diffusion of Xe at 910° C and of Rn at 1010° C through thorium oxide was proportional to the square root of the time. The activation energies of diffusion for Xe and I were of similar magnitude (about 30 kcal/mole), whilst the absolute values of the diffusion coefficients were lower for I. The activation energy of Xe in UO_2 was 49 kcal/mole. The "dose" of fast neutrons during irradiation was 10^{20} and 10^{16} nvt for ThO_2 and UO_2, respectively. For Rn^{222} the activation energy was 59 kcal/mole. R.Schnurmann

539.2

15875 **THE CROSS-SECTION OF CAPTURE OF HOLES BY γ-RAY PRODUCED DEFECTS IN GERMANIUM.**

R.F.Konopleva, S.M.Rȳvkin and I.D.Yaroshetskii.

Fiz. tverdogo Tela, Vol. 2, No. 4, 566-8 (April, 1960). In Russian.

Reports an experimental investigation of the dependence of the hole lifetime on γ-ray irradiation and a calculation of the cross-section of capture of holes by γ-ray produced defects in n-type germanium (q_p), assuming that four acceptor levels correspond to one defect. The mean value of q_p was found to be 3.8×10^{-15} cm^2 in good agreement with the reported values (of the order of 10^{-15} cm^2) for the cross-section of capture of holes by neutron-induced defects. A.Tybulewicz

539.2

15876 **IRRADIATION EFFECTS AND SHORT-RANGE ORDER IN FUSED SILICA AND QUARTZ.**

R.W.Weeks and C.M.Nelson.

J. appl. Phys., Vol. 31, No. 9, 1555-8 (Sept., 1960).

The eigenvalues of the g tensor of an irradiation produced defect of the quartz structure have been found to be $g_1 = 2.0003$, $g_2 = 2.0006$, $g_3 = 2.0018$. The data on the centre are consistent with the assignment of $S = \frac{1}{2}$. Assuming that the hyperfine interaction with Si^{29}($I = \frac{1}{2}$ and 4.7% abundant) is negligible, the envelope of the line is calculated for 3 widths of the line. Good agreement is found between the calculated emvelope for a width of 0.2 Oe and the envelope observed in γ-ray and in neutron-irradiated ($\leq 10^{18}$ fast neutrons/cm^2) silica. The observed envelope deviates from the calculated envelope for increasing neutron irradiation. It is suggested that a correlation of the Si-O tetrahedra, similar to α-quartz, exists around any point in the more common forms of silicas and has a diameter of ≥ 5 A.

539.2

15877 **A REVIEW OF THE GROSS STRUCTURAL EFFECTS OF ENERGETIC ATOMIC PARTICLES ON VITREOUS AND CRYSTALLINE SILICA.** W.Primak.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 279-86 (June, 1960).

The course of the changes resulting from irradiation and also those found on post-irradiation heating are reviewed. A hypothesis of the atomic behaviour which will account for the observations is given.

539.2

15878 **CHANGES OF THE PROPERTIES OF SiO_2 CRISTOBALITE BY MEANS OF FAST-NEUTRON IRRADIATION AND THE INTRODUCTION OF FOREIGN ATOMS.**

O.Krisement and G.Trömel.

Z. Naturforsch., Vol. 15a, No. 7, 634-40 (July, 1960) In German.

By irradiation with 1.3×10^{19} fast neutrons per cm^2 at about

50° C, the $\alpha \rightleftharpoons \beta$ inversion of pure SiO_2 cristobalite is markedly displaced to lower temperatures. The lattice parameters increase. Repeated tempering up to 500° C does not change the irradiated state. Tempering at 1600° C gives full recovery and restores the inversion temperatures before irradiation. Addition of TiO_2 to the pure SiO_2 cristobalite produces a cristobalite with similar inversion temperatures to irradiated cristobalite. The lattice parameters are also increased.

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2 : 537.3

15879 THE THEORY OF AMORPHOUS CONDUCTORS. A.I.Gubanov.

Fiz. tverdogo Tela, Vol. 2, No. 4, 651-5 (April, 1960). In Russian.

A rigorous proof is given of the band structure of the energy spectrum of electrons in a liquid or in an amorphous body. A new zero-approximation wave-function is given, which describes the motion of an electron in an amorphous body. A.Tybulewicz

539.2 : 573.3

15880 PARALLEL MEASUREMENTS OF THE ELECTRICAL CONDUCTIVITY OF ADDITIVELY COLOURED AND COLOURLESS ALKALI-HALIDE CRYSTALS. P.Tomka.

Acta phys. Hungar., Vol. 8, No. 1-2, 161-75 (1957). In German.

Gyulai's measurements and technique (Abstr. 3759 of 1959) were repeated for NaCl, NaBr and KCl crystals obtained from melts. Comparison of the experiments showed that colourless alkali halide crystals have a smaller electrical conductivity and a smaller deviation from Ohm's law than the coloured variety. It is established that colour centres (F-centres) are formed when strong conductivity currents are employed and are mainly due to crystal impurities; these centres account for the varied electrical phenomena by electronic activity. The similarity of the above phenomena to the negative photoelectric effect exhibited by silver halide crystals is referred to. H.H.Hodgson

539.2 : 537.3

15881 AN INVESTIGATION OF THE ELECTRICAL CONDUCTIVITY OF TERNARY SILVER—THALLIUM—BORON GLASSES. B.I.Markin.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 206-10 (1959). In Russian.

The glasses were prepared from boric acid, silver nitrate and thallium oxide. The total amount of Ag and Tl was kept constant at 0.01 g atom/ml and the ratio Ag/Tl was varied. The electrical conductivity of various compositions was measured at various temperatures up to 550°C. It was found that the glasses had mixed structure with equivalent Ag and Tl sites. A.Tybulewicz

539.2 : 537.3

15882 THE ELECTRICAL CONDUCTIVITY OF THE $Na_2O-RO-SiO_2$ GLASSES.

O.V.Mazurin and R.V.Brailovskaya.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1477-81 (July, 1960). In Russian.

Introduction of divalent-metal oxides (BeO, MgO, CaO, SrO, BaO, ZnO and PbO) reduced the electrical conductivity of the Na_2O-SiO_2 glasses. This was due to a stronger interaction between sodium ions and weakly polarized oxygen ions, which appeared on introduction of these oxides. A.Tybulewicz

539.2 : 537.3

15883 ELECTRICAL RESISTIVITY RECOVERY IN COLD-WORKED AND ELECTRON-IRRADIATED NICKEL.

A.Sosin and J.A.Brinkman.

Acta metallurgica, Vol. 7, No. 7, 478-94 (July, 1959).

Pure nickel wires have been subjected to electron irradiation and cold work. Electrical resistivity recovery, starting at room temperature and extending to the recrystallization range, was studied. Recovery stages near 100° C (Stage III) and 270° C (Stage IV) were found to occur by a diffusion process following cold work; dislocations are believed to be the defect sinks. Stage III was found to obey a second-order chemical rate equation following irradiation; Stage IV is essentially absent. An activation energy for defect migration of about 1.05 eV was found in Stage III following both irradiation and cold work; the energy associated with defect migration in Stage IV is not as well determined. These measuremen plus other available data on nickel indicate that the defect migrati in Stage III is an interstitial atom in Stage IV a vacancy. The clos similarity between the recovery in nickel and that in copper sugge a similar assignment in copper.

539.2 : 537.3 : 5

ELECTRICAL PROPERTIES OF THIN LAYERS OF TIN DIOXIDE. See Abstr. 16036

539.2 : 53

15884 OPTICAL MODE SCATTERING CONTRIBUTION TO ELECTRICAL RESISTIVITY IN ZIRCONIUM HYDRIDE

P.W.Bickel and T.G.Berlincourt.

Phys. Rev., Vol. 119, No. 5, 1603-4 (Sept. 1, 1960).

Electrical resistivity measurements on f.c.c. $ZrH_{1.54}$ and f.c. $ZrH_{1.96}$ between 1.2 and 400° K have revealed a sizeable optical mo scattering contribution. Excellent fits to the data are obtained usi a simple additive combination of Grüneisen and Howarth—Sondhei functions for the respective acoustical and optical mode scattering contributions. The corresponding acoustical and optical mode characteristic temperatures are in good accord with values deriv from earlier inelastic neutron scattering experiments.

539.2 : 53

15885 LORENZ NUMBER FOR HIGH-PURITY COPPER. G.K.White and R.J.Tainsh.

Phys. Rev., Vol. 119, No. 6, 1869-71 (Sept. 15, 1960).

Following a recent report (Abstr. 13228 of 1959) that the Lore number, $L = \lambda/\sigma T$, does not approximate to the theoretical value o 2.45×10^{-8}W ohm deg^{-2} for very pure copper at the lowest temper tures, measurements were made of thermal and electrical conduct ivities on copper of similar purity (99.999%). Between 2° and 4° K, values of L are observed lying in the range 2.5_4 to $2.4_0 \times 10^{-8}$W ohm deg^{-2}.

539.2 : 537.3 : 621.315.

15886 DYNAMIC CURRENT—VOLTAGE CHARACTERISTICS OF SILICON CARBIDE RESISTORS.

V.V.Pasÿnkov, G.F.Kholuyanov and L.K.Chirkin.

Fiz. tverdogo Tela, Vol. 2, No. 3, 434-7 (March, 1960). In Russia

Deals with the dynamic I—V characteristics of low-voltage non-linear silicon carbide resistors at low current densities. Th observed hysteresis of the I—V curves was due to charging and discharging of the self-capacitance of the resistors and it was not related to processes of micro-heating at contacts between silicon carbide grains. The self-capacitance of green and black varieties of silicon carbide was found to be independent of frequency in the 0.050-25 Mc/s region and of the magnitude of applied d.c. bias. A.Tybulewi

539.2 : 537.

15887 THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF A MAGNETITE MONOCRYSTAL, COOLED IN A MAGNETIC FIELD BELOW ITS LOW-TEMPERATURE TRANSITION. T.D.Zotov.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 8-10 (1959). In Russi

Magnetite monocrystals (71.00% Fe, 0.1-0.3% Ti and other impurities) were cooled from room temperature to 63.5°K in (1) a 1900 Oe longitudinal magnetic field (along the sample axis), (2) a 14 600 Oe transverse field (along the (010) axis), or (3) without a field. Differences between the electrical resistivities of the sampl subjected to these treatments were observed only below a transitio at 110.0-112.3°K. At this transition the electrical resistivity fell a factor of 14.5 to 21.5, depending on the treatment. Above 112.3° the electrical resistivity of all the samples was the same. A.Tybulewic

539.2 : 537.3 : 539.2

15888 THE EFFECT OF COLD WORK ON THE ELECTRICA RESISTIVITY OF COPPER SOLID SOLUTION ALLOYS

W.R.Hibbard, Jr.

Acta metallurgica, Vol. 7, No. 8, 565-74 (Aug., 1959).

Measurements on Cu, Cu—Al, Cu—Si and Cu—Zu of stress and strain during tensile deformation at 78°K and after subsequent recovery treatments suggest that in solid solution alloys the highe strength is primarily associated with the higher yield stress and t presence of additional or more effective dislocation barriers in th initial structure rather than the more rapid or effective generatio of dislocation barriers for a given strain during strain hardening.

characteristics of these dislocation barriers can not be deter- d from the experiments, but the alloys may contain: (1) more cations or slower moving dislocations; (2) more vacancy—solute combinations; (3) smaller substructure; (4) localized structure s such as clustering, short-range order etc. Measurements sistivity and strain during tensile deformation at 78° K and subsequent recovery treatments can be interpreted as follows:) ore stable point defects occur in the alloys, i.e. the same num- re produced in both copper and the alloys but more remain in lloys; (b) the interaction of the point defects with solute atoms ices the scattering power of the solute atoms.

539.2 : 537.3 : 538.2

VARIATION OF THE ELECTRICAL RESISTANCE OF Fe—Ni OYS UNDER AN ISOTROPIC COMPRESSION AT LOW PERATURES. See Abstr. 13775

539.2 : 537.3

5889 MAGNETORESISTANCE OF THIN FILMS OF NICKEL: PERPEDICULAR EFFECT.

oureaux and A.Colombani.

Acad. Sci. (Paris), Vol. 250, No. 26, 4310-2 (June 27, 1960). rench.

Reports experimental results for magnetoresistance of Ni films nctions of temperature in the range 20-400° C and as functions agnetic field up to 8000 Oe. Film thicknesses from 100-1000 A e employed, and were measured under high vacuum.

C.A.Hogarth

539.2 : 537.3

15890 MAGNETOELECTRIC PROPERTIES OF A MAGNETITE MONOCRYSTAL IN THE 0-100° C REGION.

.Samokhvalov and I.G.Fakidov.

. tverdogo Tela, Vol. 2, No. 3, 414-19 (March, 1960). In Russian.

These investigations showed that: (1) the "usual" Hall constant), the ferromagnetic Hall constant (R_1), the electrical resistivity and the magnetoresistance all fall on rise of temperature; $R_1 \propto \rho^m$; (3) the temperature dependences of R_0 and ρ can be ex- ned by a rise of the conduction electron density and a fall of r mobility with rise of temperature. A.Tybulewicz

539.2 : 537.3

15891 ELECTRICAL PROPERTIES OF MONOCRYSTALS OF BISMUTH AND ITS ALLOYS. I. MAGNETOELECTRIC OPERTIES OF PURE BISMUTH. D.V.Gitsu and G.A.Ivanov.

. tverdogo Tela, Vol. 2, No. 7, 1457-63 (July, 1960). In Russian.

The Hall constant and magnetoresistance of Bi monocrystals e measured in 780-18 000 Oe fields at room temperature ploying various orientations of the crystallographic axes with pect to the magnetic field and current. A.Tybulewicz

539.2 : 537.3

15892 ELECTRICAL PROPERTIES OF MONOCRYSTALS OF BISMUTH AND ITS ALLOYS. II. MAGNETOELECTRIC OPERTIES OF BISMUTH—TELLURIUM ALLOYS (SOLID LUTIONS). D.V.Gitsu and G.A.Ivanov.

. tverdogo Tela, Vol. 2, No. 7, 1464-76 (July, 1960). In Russian.

The Hall constant and magnetoresistance of Bi—Te monocrystals 02-0.5 at.% Te) were measured in 1300-18 000 Oe fields at room nperature. A phenomenological theory of magnetoelectric operties of crystals with D_{3d} symmetry (e.g. bismuth) was develop- and compared with the experimental results; the agreement was y qualitative. A.Tybulewicz

539.2 : 537.3

15893 MAGNETORESISTANCE OF COPPER, SILVER AND GOLD. M.G.Priestley.

il. Mag. (Eighth Ser.), Vol. 5, 111-14 (Feb., 1960).

It is shown that the magnetoresistance measurements of ekseevskii and Gaidukov (Abstr. 9939 of 1960) on single crystals of pper, silver and gold are consistent with the Fermi surfaces of ese metals proposed on the basis of anomalous skin effect and de as—van Alphen effect measurements.

539.2 : 537.3

15894 EFFECT OF OXYGEN ON THE MAGNETORESISTANCE OF COPPER. R.L.Dolecek.

hys. Rev., Vol. 119, No. 5, 1501-2 (Sept. 1, 1960).

To determine the influence of physical and/or chemical impu- ties on the high-field magnetoresistance of copper, measurements ere made of the effect on specimen properties of work hardening d the presence of O_2 in the atmosphere used for annealing. A Kohler plot of the transverse magnetoresistance for all specimens gave a single smooth curve. The plot for the longitudinal magnetoresistance of any one specimen, as the concentration of defects was increased between successive measurements, also gave a smooth curve. However, the saturation value of the longitudinal magnetoresistance was markedly affected by annealing in an atmosphere containing O_2. The zero-field ratio of transverse to longitudinal magnetoresistance was found to be quite insensitive to work hardening and the presence of O_2 in the annealing atmosphere.

539.2 : 537.3

15895 THE EFFECTS OF ANISOTROPIC RELAXATION TIMES ON THE HALL COEFFICIENTS OF SOME DILUTE ALLOYS OF SILVER. J.R.A.Cooper and S.Raimes.

Phil. Mag. (Eighth Ser.), Vol. 4, 145-57 (Feb., 1959).

A theory of the Hall effect in dilute alloys of a monovalent metal is developed, taking into account the effects of non-spherical energy surfaces and anisotropic relaxation times. The total relaxation time is assumed to be compounded of a thermal relaxation time which is anisotropic, and an impurity relaxation time which is isotropic. The wave number and the thermal relaxation time are expanded in series of cubic harmonics up to that of order four, and the conductivity and Hall coefficient are calculated in terms of the coefficients in these series. The theory is applied to some measurements made by Dorfman and Zhukova (1939) on dilute alloys of palladium, platinum, cadmium, tin, and antimony in silver, with reasonable success, but is unable to explain similar measurements made by Onnes and Beckman (1912) on the silver—gold system. The results indicate that, if a relaxation time exists, it must be considerably anisotropic, in which case it is found that the Fermi surface in pure silver need not depart from sphericity sufficiently to touch the Brillouin zone boundary.

539.2 : 537.3

15896 A THEORY OF THERMALLY STIMULATED CURRENT. V.E.Khartsiev.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 104-9 (1959). In Russian.

Gives a theory of the "thermally stimulated current" method of studying trapping levels in solids: a previously excited sample, across which a potential difference is applied, is slowly heated and current peaks, each representing emptying of trapping levels of a given type, are observed. A.Tybulewicz

539.2 : 537.3 : 537.533

15897 GENERATION OF E.M.F.'S IN LEAD SULPHIDE FILMS ON BOMBARDMENT WITH SLOW ELECTRONS.

O.M.Artamonov and L.P.Strakhov.

Fiz. tverdogo Tela, Vol. 2, No. 4, 775-6 (April, 1960). In Russian.

The films, produced by deposition in vacuo, were bombarded with 3-300 eV electrons and the resultant e.m.f.'s were measured. The magnitudes and signs of the e.m.f.'s depended on the direction and energy of the incident electrons and on the electron beam intensity. At certain "critical" angles of incidence (of the order of 60° to the normal) the e.m.f.'s, which were usually about 0.01 V, rose to 1 V and power amplification occurred: with a beam current of 10^{-8} A and an electron energy of 100 eV, the e.m.f. was of the order of 1 V and the short-circuit current reached 10^{-6} A. Simultaneous illumination and electron bombardment yielded e.m.f.'s which were algebraic sums of the e.m.f.'s produced by light and electrons separately. A.Tybulewicz

Semiconductors

539.2 : 537.311 : 621.317.331

15898 MEASUREMENT OF THE SHEET RESISTIVITY OF A SQUARE WAFER WITH A SQUARE FOUR-POINT PROBE. F.Keywell and G.Dorosheski.

Rev. sci. Instrum., Vol. 31, No. 8, 833-7 (Aug., 1960).

The sheet resistivity of a thin sample of semiconductor may be measured by the placement of four probes on the surface of the sample. When current is passed between two of the probes, the potential difference between the other two probes is proportional to the current and the sheet resistivity of the sample. Sheet resistivity is then proportional to p.d./current, the proportionality or correction factor being dependent on the geometry of the sample and the probe. Calculations have been made for the correction factors in the case of a square probe array placed symmetrically on a square wafer.

The correction factors for conversion of p.d./current to sheet resistivity are given for square dimensions, in units of probe spacing, over the range one to 50. The data include the special case d/s = 1 wherein the probe points are on the corners of the square.

539.2 : 537.311

15899 THE P—N JUNCTION IN A THERMAL GRADIENT. W.Klose.

Ann. Phys. (Leipzig), Vol. 6, No. 1-2, 25-30 (1960). In German.

Due to the thermal gradient an additional electric current flows in the blocking direction. The unsymmetrical contribution to the thermal transport by electron and hole conduction is probably unobservable owing to the preponderance of the thermal conduction by the lattice. F.Ansbacher

539.2 : 537.311

15900 ON THE DETERMINATION OF CONCENTRATION AND MOBILITY OF CHARGE CARRIERS IN TWO-CARRIER SEMICONDUCTORS. L.Gombay, J.Gyulai and J.Láng.

Acta phys. Hungar., Vol. 8, No. 1-2, 203-9 (1957). In German.

A simple method is given which serves to evaluate four parameters: the concentrations and the mobilities of both electrons and holes. The measurements which are assumed given are: conductivity Hall effect, thermoelectric power and the change in conductivity in a transverse magnetic field. The formulae used are of standard type. The question of adding a fifth measurement in order to test for self-consistency is not discussed. P.T.Landsberg

539.2 : 537.311

15901 THEORY OF THE ADDITIONAL ELECTRICAL CONDUCTIVITY AND THERMIONIC EMISSION OF A SEMICONDUCTOR, DUE TO BOMBARDMENT WITH FAST ELECTRONS. A.A.Ostroukhov and K.B.Tolpÿgo.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 17-29 (1959). In Russian.

A theory of the additional conductivity due to fast-electron bombardment is developed for both monopolar and dipolar conduction. Assuming a uniform distribution of the additional current carriers and a small rise of the conductivity, a solution is obtained for the case of square pulses of the incident-beam intensity. Assuming that the additional carriers are practically in thermal equilibrium with the lattice, thermionic emission of the semiconductor is calculated. It is found that secondary emission consists of two components: an inertialess component due to "fast" secondary electrons, and a temperature-dependent component with inertia, which is due to the additional electrons in thermal equilibrium with the lattice. A.Tybulewicz

539.2 : 537.311

15902 GLASSY SEMICONDUCTORS. V. THE ROLE OF IMPURITIES IN THE ELECTRICAL CONDUCTION BY GLASSY SEMICONDUCTORS. B.T.Kolomiets and T.F.Nazarova.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 22-8 (1959). In Russian.

For Pt IV, see Abstr. 3454 of 1959. Studies of the dark and photoconductivity of $Tl_2Se.As_2Se_3$ glasses, with large (up to 43 at.%) excesses of Se, Tl or As, and of $As_2Se_3.Se_2Te_3$ glasses with foreign impurities (e.g. 10% Pb) showed that even large variations of composition do not prevent vitrification and affect comparatively weakly the dark and photoconductivities. It was concluded that the large jumps of the conductivity observed on crystallization of these glasses is due to the presence of excess components or impurities, which do not affect greatly the electrical conductivity of glasses but are a dominant influence in crystals. A.Tybulewicz

539.2 : 537.311

15903 GLASSY SEMICONDUCTORS. VI. INTERNAL PHOTOEFFECT [PHOTOCONDUCTIVITY] IN MOLTEN $4As_2Se_3.As_2Te_3$ GLASS. B.T.Kolomiets and T.N.Mamontova.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 29-31 (1959). In Russian.

The magnitudes of dark and photoconductivities and the photoconductivity spectrum of the $4As_2Se_3.As_2Te_3$ glass did not exhibit any sudden changes at the softening temperature near 150° C or at temperatures up to 70° C above it. It was concluded that the short-range order was conserved on melting and that it was likely to be retained also on crystallization. A.Tybulewicz

539.2 : 537.311

15904 BOUNDARY CONDITIONS AT THE SURFACE IN THE PROBLEM OF BIPOLAR DIFFUSION OF CARRIERS IN A SEMICONDUCTOR. Z.S.Gribnikov.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 30-5 (1959). In Russian.

Boundary conditions at the surface of a semiconductor are derived with allowance for the motion of carriers in the space-charge region near the surface. These conditions are, in general, in the form of a system of differential equations, which reduce to a single equation in the case of low minority-carrier density. A.Tybulewic

539.2 : 537.3

15905 INVESTIGATION OF THE DIFFUSION OF MINORITY CARRIERS IN A MAGNETIC FIELD. S.M.Rȳvkin, A.A.Grinberg, Yu.L.Ivanov, S.R.Novikov and N.D.Potekhina.

Fiz. tverdogo Tela, Vol. 2, No. 4, 575-90 (April, 1960). In Russian

Reports a theoretical and experimental investigation of the distribution of the minority carrier density in a magnetic field und conditions of injection at "a point". This distribution can be found easily by measuring the longitudinal magneto-concentration effect, and it can be used to determine the "microscopic" drift mobility of carriers, and relationships between densities of carriers of the same sign but of different masses. The suggested method was use to find that the ratio of light to heavy holes in germanium is about 2%. A.Tybulewic

539.2 : 537.31

15906 THE INFLUENCE OF GEOMETRICAL DIMENSIONS O SAMPLES IN MEASUREMENTS OF THE DIFFUSION LENGTH USING THE PHOTOMAGNETIC METHOD. E.G.Landsbe

Fiz. tverdogo Tela, Vol. 2, No. 5, 848-53 (May, 1960). In Russian.

Reports an investigation of the influence of geometrical dimensions of samples on the diffusion length obtained by simultaneous measurement of the photomagnetic effect and photoconductivity. An experimental proof is given of Moizhes' suggestion (Abstr. 6132 of 1960) that the unidimensional theory is applicable t samples partially illuminated, provided the length of the illuminate part and of the dark ends are all much greater than the diffusion length. Determination of the carrier lifetime from measurements the photomagnetic effect on the illuminated and dark sides of the sample was also attempted. A.Tybulewic

539.2 : 537.3

15907 RECOMBINATION COEFFICIENTS IN THE PRESENC OF A COULOMB BARRIER. V.L.Bonch-Bruevich.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 182-5 (1959). In Russian.

Gives a quantum-mechanical treatment of the effect of a Coulo repulsion field on the temperature dependence of the cross-section of capture of current carriers by impurity centres in covalent. semiconductors. A.Tybulewi

539.2 : 537.31

15908 DETERMINATION OF THE RECOMBINATION PARAMETERS FROM THE SPECTRAL RESPONSE OF A PHOTOCELL WITH A P—N JUNCTION. V.K.Subashiev.

Fiz. tverdogo Tela, Vol. 2, No. 2, 205-12 (Feb., 1960). In Russian.

The photoconductivity response of a photocell with a p—n junction is analysed using the formulae of Bir and Pikus (Abstr. 9197 of 1957). It is shown how the experimental photoconductivity response can be used to obtain the recombination parameters and the position of the p—n junction. A.Tybulewic

539.2 : 537.31

15909 DETERMINATION OF THE RECOMBINATION PARAMETERS FROM THE SPECTRAL RESPONSE OF A PHOTOCELL WITH A P—N JUNCTION. II. G.B.Dubrovskii and V.K.Subashiev.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1562-71 (July, 1960). In Russian.

The results reported in Pt I (see preceding abstract) and measurements of the absorption coefficient, the reflection coefficie and the quantum yield of the internal photoeffect (photoconductivity) were used to find the recombination parameters of silicon photoresistors. A.Tybulewic

539.2 : 537.31

15910 A THEORY OF THE ELECTRICAL BREAKDOWN OF SEMICONDUCTORS. I. V.A.Chuenkov.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 200-8 (1959). In Russian.

The distribution of electrons (holes) in a semiconductor in a strong electric field is found by solving the kinetic equation with allowance for scattering on thermal vibrations of the lattice, ionization by electron collisions, thermal excitation and recombination This distribution is used to show that, with increase of the electric field intensity, the mean number of ionizations (per one electron pe ime) rises and the mean number of recombinations falls. This s that, at a certain critical value of the electric field intensity, inetic equation ceases to have a steady-state solution (the ron and hole densities tend to infinity), i.e. electrical breakdown of the semiconductor takes place. The critical field depends slightly on the ionization and recombination cross-sections s governed mainly by scattering on the lattice vibrations.

A.Tybulewicz

539.2 : 537.311

5911 A THEORY OF THE ELECTRICAL BREAKDOWN OF SEMICONDUCTORS (P—N JUNCTIONS). V.A.Chuenkov.

tverdogo Tela, Sbornik [Supplement] II, 209-14 (1959). In ian.

The kinetic equation for electrons (holes) in p—n junctions is ed for high inverse voltages. The distribution function obtained is way is used to calculate the collision ionization coefficient to formulate a criterion of breakdown of p—n junctions. The perature dependence of the critical (breakdown) field is obtained.

A.Tybulewicz

539.2 : 537.311

15912 THE PROBLEM OF INTERNAL BREAKDOWN IN NON-POLAR SEMICONDUCTORS. G.V.Gordeev.

tverdogo Tela, Vol. 2, No. 4, 611-19 (April, 1960). In Russian.

Internal breakdown in pure non-polar semiconductors is dissed. It is shown that equality of the energy obtained by electrons n the applied field and the energy transferred by electrons to lattice may occur at any electron temperature. Consequently internal breakdown criterion of Fröhlich and Paranjape str. 2144 of 1956), who suggested that this equality is not obeyed inite electron temperatures, loses its physical sense for nonr semiconductors. A different internal breakdown criterion ntroduced, and this criterion allows for ionization and recombion.

A.Tybulewicz

539.2 : 537.311

15913 ELECTRICAL CONDUCTION IN VALENCE SEMICONDUCTORS AT LOW TEMPERATURES IN STRONG ECTRIC FIELDS. V.A.Chuenkov.

. tverdogo Tela, Vol. 2, No. 5, 799-809 (May, 1960). In Russian.

Gives the mean probability of collision ionization and of recomation, the electron (hole)density and the current density as ctions of the applied electric field. Derives a criterion for lowperature electrical breakdown in valence semiconductors.

A.Tybulewicz

539.2 : 537.311

15914 ACTIVITY COEFFICIENTS OF ELECTRONS AND HOLES AT HIGH CONCENTRATIONS. A.J.Rosenberg.

chem. Phys., Vol. 33, No. 3, 665-7 (Sept., 1960).

The use of the mass-action law in connection with solid-state uilibria involving conduction electrons or holes assumes that the emical potential of the species is related to its concentration by

$$\mu = \mu^0(T) + kT \ln n.$$

is approximation can fail at concentrations which are still very nall by ordinary chemical standards. The formalism may be eserved in principle by introducing a suitable activity coefficient It is shown theoretically, however, that γ increases almost ponentially with increasing n when $n/\lambda >\sim 0.1$, where λ is the rtition function in the quasi-free-particle approximation. As a nsequence, the proper exponent of n in mass-action equations comes much larger than expected from stoichiometry considerans alone. The use of such equations becomes difficult, therefore, hen $n/\lambda >\sim 0.5$, and entirely unjustified when $n/\lambda >\sim 10$. The termination of λ, which lies between 10^{16} and 10^{21} cm^{-3} for most miconductors, is discussed from an experimental viewpoint.

539.2 : 537.311

15915 SURFACE STUDIES ON P—N JUNCTIONS. I.Stelzer.

. Electronics and Control, Vol. 8, No. 1, 39-57 (Jan., 1960).

Semiconductor surface theory relevant to the understanding of e behaviour of p—n junctions is reviewed. In order to predict the ffect of an adsorbed chemical species on the surface potential the eory of chemisorption is extended to relate the surface trapping vel (under certain idealized conditions) to the electronegativity of e adsorbate. It is found experimentally for silicon that the magitude of the junction reverse current alters when the surface potential changes, for instance as a result of exposure to sulphur dioxide or diethylamine, but that this change is not due primarily to a change in activation energy. The activation energy remains unchanged as it is (in the case of silicon) governed by the underlying bulk states and not by the surface states.

539.2 : 537.311

15916 SOLUBILITY OF FLAWS IN HEAVILY-DOPED SEMICONDUCTORS. W.Shockley and J.L.Moll.

Phys. Rev., Vol. 119, No. 5, 1480-2 (Sept. 1, 1960).

The solubility of a charged impurity in a semiconductor depends upon the Fermi level. This dependence may be understood in terms of a conceptual model in which an impurity is allowed to diffuse in a specimen containing a p—n junction, so that the Fermi level varies in respect to the band edges. If the impurity can exist in many states of charge (i.e., is a "flaw"), then the concentration of flaws with charge r times the electronic charge varies as the r-th power of the hole density. Summing the concentrations for the different states of charge gives the solubility and its dependence upon hole concentration, and, hence, Fermi level.

539.2 : 537.311

15917 CASCADE CAPTURE OF ELECTRONS IN SOLIDS. M.Lax.

Phys. Rev., Vol. 119, No. 5, 1502-23 (Sept. 1, 1960).

Enormous capture cross-sections in the range 10^{-15} to 10^{-12}cm^2 have been observed for a wide variety of Coulomb attractive centres in Si and Ge, some involving binding energies many times the Debye energy. Whereas multiphonon transitions to the ground-state yield cross-sections five to ten order of magnitude too small, capture into excited states of large radius followed by a cascade of one phonon transitions leads to cross-sections of the right order of magnitude. The initial capturing event is likely to involve an optical phonon or an intervalley collision in the room temperature range, but the acoustic phonon contribution will predominate at low temperatures. Subsequent collisions may eject the electron or cause it to increase its binding energy. The "sticking probability", or probability of eventual capture into the ground state, becomes significant for binding energies of order kT. As the temperature is reduced capture into orbits of larger radius become effective, and at least for the acoustic phonon case the cross-section increases rapidly with decreasing temperature, and with decreasing electron energy. The large cross-sections 10^{-17} to 10^{-15} cm^2 found for neutral centres can be explained on a similar basis, the attractive potential in this case being provided by the large polarizability of the neutral centre.

539.2 : 537.311

15918 THE APPEARANCE OF INSTABILITY IN A SEMICONDUCTING AMPLIFIER WITH NEGATIVE EFFECTIVE MASS OF THE CARRIERS. A.L.Zakharov.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 665-7 (Feb., 1960). In Russian.

Discusses how instability can arise: if in a certain microvolume, a small accumulation of positive charge occurs through thermal fluctuations in the hole density, the resulting field produces a current flowing towards the charge (in [100] direction passing through the charge). The charge will grow exponentially with time constant of dielectric relaxation, until the perpendicular field produced is strong enough for the conductivity in it to be positive. An analogous effect is produced by a fluctuation reducing the hole density. It is concluded that NEMAG (Krömer, Abstr. 5960 of 1959) will be a noisy amplifier and that the distribution of charges and fields and the properties in general will be much more complicated than suggested by Krömer.

R.Berman

539.2 : 537.311 : 621.375.9

15919 ON THE QUESTION OF NEW POSSIBILITIES OF AMPLIFICATION BY THE MOVEMENT OF CARRIERS IN SEMICONDUCTORS. E.Groschwitz.

Z. angew. Phys., Vol. 12, No. 8, 370-82 (Aug., 1960). In German.

Methods are considered in a general way, by which amplification might be achieved using charge carriers of negative effective mass.

J.Franks

539.2 : 537.311 : 621.382

15920 FIELD EFFECT MEASUREMENTS IN A TRANSVERSE MAGNETIC FIELD. E.Aerts, S.Amelinckx and J.Vennik.

J. Electronics and Control, Vol. 7, No. 6, 497-504 (Dec., 1959).

Field effect measurements were carried out in a transverse magnetic field. A systematic study at different magnetic field-strengths revealed that the polarity of the space-charge layer could be inverted by a suitably chosen magnetic field. At the same time the behaviour of the magnetoresistance was studied. A qualitative interpretation of both phenomena is proposed.

539.2 : 537.311 : 535

ABSORPTION OF INFRARED RADIATION BY SEMICONDUCTORS IN AN ELECTRIC FIELD. See Abstr. 13682

539.2 : 537.311

15921 MEASUREMENTS OF DEVIATIONS FROM OHM'S LAW AND THE EFFECT OF NOISE SHOWN BY VERY THIN POLYCRYSTALLINE FILMS OF GERMANIUM. C.Uny.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4337-9 (June 27, 1960). In French.

Experimental results are given for thin layers deposited in vacuo on amorphous silica substrates. C.A.Hogarth

539.2 : 537.311

15922 DETERMINATION OF THE RATIOS OF THE ELECTRON AND HOLE CAPTURE CROSS-SECTIONS FOR ATOMS OF COPPER IN GERMANIUM. K.Konstantinesku.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1766-8 (Nov., 1959). In Russian.

Using the method described by Kalashinkov and Konstantinesku (Abstr. 6091 of 1960) the author has determined the approximate values of C_p/C_n (where C_p and C_n are hole and electron capture cross-sections, respectively) for Cu atoms in Ge. Values of the order of 10 (p-type Ge) and 100 (n-type Ge) were obtained. M.H.Sloboda

539.2 : 537.311

15923 COMBINED INVESTIGATION OF THE SURFACE PROPERTIES OF GERMANIUM. I. THE EFFECT OF AN EXTERNAL ELECTRIC FIELD ON THE ELECTRICAL CONDUCTIVITY, HALL CONSTANT AND MAGNETORESISTANCE OF GERMANIUM. V.I.Lyashenko, O.V.Snitko and T.N.Sÿtenko.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 3-10 (1959). In Russian.

Reports a study of a thin slab of germanium etched in boiling H_2O_2. Dependence of these properties on the curvature of energy bands at the surface was found and the existence of two types of surface levels was established. The levels were either of acceptor type with a density of 4×10^{11} cm^{-2}, lying (5.5 ± 0.5) kT/e above the middle of the forbidden band, or of donor type with a density of 6×10^{11} cm^{-2}, lying (6.0 ± 0.5) kT/e below the middle of the forbidden band. A.Tybulewicz

539.2 : 537.311

15924 COMBINED INVESTIGATION OF THE SURFACE PROPERTIES OF GERMANIUM. II. THE EFFECT OF AN EXTERNAL ELECTRIC FIELD ON THE PHOTOCONDUCTIVITY, MINORITY-CARRIER LIFETIME AND CAPACITOR PHOTO-E.M.F. V.I.Lyashenko, O.V.Snitko and T.N.Sytenko.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 11-16 (1959). In Russian.

Reports a study of a thin slab of germanium etched in boiling H_2O_2. Dependence of these properties on the curvature of energy bands at the surface was found. In the case of surface recombination and of photo-e.m.f., the experimental results agreed satisfactorily with theoretical predictions, and were therefore used to deduce the properties of the surface recombination levels (which were the same as in Pt I; see preceding abstract). A.Tybulewicz

539.2 : 537.311

15925 THE EFFECT OF DEFECTS PRODUCED BY NEUTRON IRRADIATION ON THE PROCESS OF RECOMBINATION IN GERMANIUM.

R.F.Konopleva, T.V.Mashovets and S.M.Rÿvkin.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 11-12 (1959). In Russian.

Germanium samples of n-type, irradiated with 14 MeV neutrons, had the following properties: (1) the activation energy of the recombination levels was 0.20 eV; (2) the mean cross-section of capture of holes by these levels was 1.6×10^{-15} cm^2; (3) the dependence of the concentration of neutron-produced defects on the duration of subsequent annealing at 150 or 200°C was not exponential, but it did agree with Waite's theory (Abstr. 2048-9 of 1958). A.Tybulewicz

539.2 : 537.311

15926 THE ENERGY DISTRIBUTION OF ELECTRON STATES ON A GERMANIUM SURFACE AT VARIOUS TEMPERATURES. V.I.Lyashenko and N.S.Chernaya.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 110-13 (1959). In Russian.

The field effect was studied at the surface of p-type germanium in vacuo (~10^{-9} mm Hg) at temperatures of 290°, 264°, 243° and 232°K. The densities N and the energy depths E of the surface sta indicated the presence of one acceptor (N ~ 2×10^{-12} cm^{-2}, E of 0.13 eV) and three donor levels (N ~ 1, 1.1 and 1.5×10^{-13} cm^{-2}, E of −0.02, −0.09 and −0.18 eV, respectively). The values of N an E were found to be independent of temperature. A.Tybulewi

539.2 : 537.3

15927 ELECTRICAL AND RECOMBINATION PROPERTIES GERMANIUM WITH BERYLLIUM IMPURITY.

V.E.Lashkarev, R.N.Bondarenko, V.N.Dobrovol'skii, G.P.Zubrin, V.G.Litovchenko and V.I.Strikha.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 39-46 (1959). In Russian.

It was found that beryllium in germanium is a doubly ionized acceptor at room temperature. The activation energy of the upper beryllium level was found to be 0.07 ± 0.005 eV. The distribution coefficient lay between 1 and 0.1. The diffusion coefficient of Be i Ge at 850°C did not exceed 10^{-11} cm^2/sec; the solubility was of the order of 10^{19} cm^{-3}. Recombination at room temperature occurred through levels lying 0.17 ± 0.01 eV above the upper edge of the valence band. The carrier lifetime was 14 μsec when the traps were empty. A.Tybulewi

539.2 : 537.3

15928 THE EFFECT OF THE TREATMENT OF GERMANIUM WITH LEAD ON THE NON-EQUILIBRIUM CARRIER LIFETIME. A.K.Mednikov.

Fiz. tverdogo Tela, Vol. 2, No. 2, 235-8 (Feb., 1960). In Russian.

Reports a study of the effect of the extraction and introduction of copper by means of molten lead on the non-equilibrium carrier lifetime. Removal of traces of copper from germanium reduced th diffusion path length of minority carriers and subsequent introducti of copper first increased this length and then reduced it again. Fr these results, some conclusions are drawn on the interaction of recombination centres in germanium. A.Tybulewic

539.2 : 537.31

15929 INVESTIGATION OF THE SURFACE ELECTRICAL CONDUCTIVITY OF GERMANIUM MONOCRYSTALS.

V.A.Presnov and V.F.Sÿnorov.

Fiz. tverdogo Tela, Vol. 2, No. 3, 381-7 (March, 1960). In Russian

Reports an investigation of the changes in the electrical conductivity of monocrystalline germanium samples produced by various surface treatments (etching, sand blasting, washing in methyl alcohol) and coatings. Coating a p-type sample with a lacquer consisting of polar molecules reduced the surface conductivity; the opposite effect was observed in n-type samples. A.Tybulewic

539.2 : 537.311

15930 THERMAL CONDUCTIVITY OF P- AND N-TYPE GERMANIUM SAMPLES WITH VARIOUS CARRIER DENSITIES AT 80-440°K. E.D.Devyatkova and I.A.Smirnov.

Fiz. tverdogo Tela, Vol. 2, No. 4, 561-5 (April, 1960). In Russian.

The thermal conductivities (k) of p- and n-type germanium were found to be different. Up to 320°K the value of k of n-type samples was smaller than that of p-type. Between 80 and 320°K both types of samples obeyed a relationship $1/k \propto T$, where T is the absolute temperature. Among reasons suggested for the difference between the thermal conductivities of p- and n-type germanium was the presence of dissolved gases (O_2, H_2, N_2, etc) in n-Ge which reduced the latter's thermal conductivity. See also Abstr. 1361 of 1959. A.Tybulewicz

539.2 : 537.311

15931 ANISOTROPY OF THE SURFACE BREAKDOWN OF GERMANIUM IN STRONG FIELDS. A.I.Morozov.

Fiz. tverdogo Tela, Vol. 2, No. 4, 620-3 (April, 1960). In Russian.

Describes breakdown channels observed on the surface of n- and p-type germanium (0.1-40 ohm cm) subjected to strong current pulses through a point contact. These channels indicate anisotropy of the surface breakdown in strong fields and at high current densities. A.Tybulewicz

539.2 : 537.311

15932 PROPERTIES OF GERMANIUM IN A STRONG ELECTRIC FIELD. G.M.Avak'yants.

Fiz. tverdogo Tela, Vol. 2, No. 5, 810-14 (May, 1960). In Russian.

Reports an analysis of the experimentally observed variation of the hole mobility in p-type germanium with the magnitude of an applied strong electric field. It is shown that Paranjape's theory

r. 7907 of 1957) is unable to explain the results. A different retation is proposed, which is based on the interaction of with acoustic and optical vibrations of the lattice.

A. Tybulewicz

539.2 : 537.311

933 A CONTROLLED DIFFUSION PROCESS FOR INDIUM IN N-TYPE GERMANIUM.

rson, M.J.Dyett, C.Karan and W.E.Mutter.

ectrochem. Soc., Vol. 107, No. 5, 459-61 (May, 1960).

A technique for making a p–n junction on n–type germanium preventing thermal conversion due to the presence of copper germanium is described. The copper was removed by a layer olten indium heated in contact with the germanium. At the same the indium vapour pressure was sufficiently high to diffuse a pe skin. In order to reduce the density gradient of In in the Ge, xed layer of indium and tin was used, thus affording greater ol over the diffused junction. .

I.Cooke

539.2 : 537.311

5934 LOW-TEMPERATURE IMPURITY CONDUCTION AND MAGNETORESISTIVITY IN n-TYPE GERMANIUM.

avinszky.

. Rev., Vol. 119, No. 5, 1605-9 (Sept. 1, 1960).

The resistivity of several lightly doped (Sb) n-type Ge samples calculated and compared with values measured at 2.5° K. An r of magnitude agreement was obtained for a span of five orders agnitude in the resistivities. It was assumed that the mechanism nductivity consists of jumping of electrons from occupied to y donors. The number of charge carries was determined by lating the number of "free" donor ions. The "trapped" donor due to the presence of charged compensating acceptors, were med not to participate in the conduction process. The effect of nstant magnetic field on impurity conduction was also investigated a simple theory of magneto-resistivity is presented. The ulated magnetoresistive ratio is in order of magnitude agreement the measured value.

539.2 : 537.311

5935 EFFECT OF SHEAR ON IMPURITY CONDUCTION IN N-TYPE GERMANIUM. H.Fritzsche.

s. Rev., Vol. 119, No. 6, 1899-900 (Sept. 15, 1960).

Shear strains, which change the donor wave-functions, greatly ct impurity conduction, which depends sensitively on the wave-tion overlap of neighbouring impurity states. The change of im-ty conduction of germanium containing 5.2×10^{15} antimony atoms cm^3 and about 3% compensation was measured at 1.9° K as a tion of shear strains produced by uniaxial tension and com-ssion along [110]. It is shown that the anisotropy and the satura- of the conductivity changes observed at stresses larger than 10^8 dyne/cm^2 can be understood from the strain-induced changes he donor state wave-functions.

539.2 : 537.311 : 538.2

ANISOTROPY OF THE GALVANOMAGNETIC EFFECT IN A YSTAL OF N-TYPE GERMANIUM AT TEMPERATURES OF THE ANSITIONAL REGION OF CONDUCTIVITY. See Abstr. 13816

539.2 : 537.311

15936 IMPURITY REDISTRIBUTION AND JUNCTION FORMATION IN SILICON BY THERMAL OXIDATION.

M.Atalla and E.Tannenbaum.

1 Syst. tech. J., Vol. 39, No. 4, 933-46 (July, 1960).

In the process of growing an oxide on doped silicon, electrically ive impurities near the silicon/silicon dioxide interface are istributed according to the diffusion coefficients and the distribu- coefficients of the impurity between the oxide and the semi-ductor. An analysis of the phenomenon predicts that single-ction or two-junction material can be obtained by oxidation of the face of a compensated silicon crystal. For parabolic growth of oxide, the surface concentration is independent of time; and the ction depth, gradient and sheet resistivity vary with $t^{1/2}$. This has n demonstrated experimentally by oxidation of a compensated ype silicon crystal doped with gallium and antimony.

539.2 : 537.311

15937 IMPACT IONIZATION IN SILICON P–N JUNCTIONS.

B.M.Vul and A.P.Shotov.

. tverdogo Tela, Sbornik [Supplement] I, 150-4 (1959). Russian.

Multiplication of electrons and holes was studied in strong ctric fields. It was found that the coefficient of impact ionization of electrons is about 4.5 times higher than that of holes and that this ratio is independent of the applied electric field intensity.

A.Tybulewicz

539.2 : 537.311

15938 THE SURFACE PROPERTIES OF SILICON.

V.G.Litovchenko and O.V.Snitko.

Fiz. tverdogo Tela, Vol. 2, No. 4, 591-604 (April, 1960). In Russian.

Reports a study of the effect of an external electric field on the electrical conductivity, the "field-effect mobility", and its kinetics, the surface recombination and the photo-e.m.f. in monocrystalline n-type silicon. Comparison of the results with theory yielded information on the densities, the energy positions, and the capture cross-sections of the surface levels in etched silicon.

A.Tybulewicz

539.2 : 537.311

15939 LONG-TERM VARIATIONS OF THE FIELD EFFECT IN SILICON. V.G Litovchenko and O V.Snitko.

Fiz. tverdogo Tela, Vol. 2, No. 5, 815-22 (May, 1960). In Russian.

It is shown that the main cause of long-term variations ($t > 10$ sec) of the field effect in silicon is the presence of water vapour in the atmosphere. Removal of moisture or, better, carrying out the measurements in vacuum avoids these long-term variations. Surface conductivity additional to that known as "quasi-surface" conductivity was observed on raising the applied electric field intensity above a certain critical value ($\cong 1.2 \times 10^6$ V/cm).

A.Tybulewicz

539.2 : 537.311

15940 EFFECT OF Li–B ION PAIRING ON Li^+ ION DRIFT IN Si. E.M.Pell.

J. appl. Phys., Vol. 31, No. 9, 1675-9 (Sept., 1960).

When Li^+ and B^- ions are present simultaneously in Si, relatively immobile Li–B ion pairs are formed. Only those Li^+ ions which have not become paired with B^- are free to diffuse through the Si, and measurement of the effective diffusion rate of the Li^+ can thus be used to determine the fraction of Li^+ paired. Such measurements have been made in the range 2°-100° C using the method of ion drift in a p–n junction. The results agree well with the Reiss model for ion pairing, yielding a distance of closest approach between Li^+ and B^- of 2.5-2.8 A. This value is larger than that given by the sum of Li^+ and B^- radii; it is roughly equal to the distance from a lattice-atom site to the next-nearest interstitial site (2.72 A). The kinetics of the ion-pairing reaction have been investigated by the same technique. The resulting value for the capture radius of the B^- ion agrees satisfactorily with theory.

539.2 : 537.311

15941 REACTIONS OF GROUP III ACCEPTORS WITH OXYGEN IN SILICON CRYSTALS.

C.S.Fuller, F.H.Doleiden and K.Wolfstirn.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 187-203 (June, 1960).

Hall effect and conductivity results are presented on Si crystals containing from 5×10^{17} to 1.6×10^{18} cm^{-3} of oxygen and various dopings of B, Al and Ga before and after reaction at various temperatures (410-1350° C). Evidence in support of the tetrahedral SiO_4 model for the donor formed from oxygen suggested by Kaiser is presented. A large hole—electron effect is noted in the presence of excess acceptor concentration. In addition, specific interactions with the acceptor atoms occur. Although the reactions are complex and are not understood, three kinds are postulated in order to account for the results: (1) The formation of isolated SiO_4 donors such as occurs in undoped Si crystals containing oxygen. (2) The reaction of oxygen at an acceptor atom to form a neutral compound or a "molecular pair". (3) The formation of a donor involving eight oxygen atoms and an acceptor atom. The latter reaction is believed to occur most readily in the case of Al-doped crystals and, in an excess of oxygen, leads to the formation of one donor per Al atom.

539.2 : 537.311 : 535

IMPURITY ABSORPTION OF LIGHT IN Si. See Abstr. 13685

539.2 : 537.311

15942 ELECTRICAL PROPERTIES OF CERTAIN SEMICONDUCTING OXIDE GLASSES.

V.A.Ioffe, I.B.Patrina and I.S.Poberovskaya.

Fiz. tverdogo Tela, Vol. 2, No. 4, 656-62 (April, 1960). In Russian.

The electrical conductivity, thermoelectric power, dielectric losses and permittivity of glasses in the systems $V_2O_5-P_2O_5$, $V_2O_5-P_2O_5-BaO$ and $WO_3-P_2O_5-K_2O$ were investigated. All these glasses are n-type semiconductors. The electrical conductivity of the glasses rises on increase of the content of the oxides of transition metals. The mechanism of electrical conduction of the glasses is similar to the mechanism in crystalline oxides of transition metals Maxima were found in the temperature dependence of tan δ of the glasses. The activation energy of relaxation is close in magnitude to the activation energy of electrical conduction. A.Tybulewicz

539.2 : 537.311 : 548

PECULIARITIES OF THE CRYSTAL CHEMISTRY OF TRANSITION METAL SEMICONDUCTING COMPOUNDS. See Abstr. 13932

539.2 : 537.311

15943 SOME ELECTRICAL PROPERTIES OF THE AlSb—InSb SYSTEM. Ya.Agaev and D.N.Nasledov.
Fiz. tverdogo Tela, Vol. 2, No. 5, 826-9 (May, 1960). In Russian.

Reports a study of the electrical conductivity, Hall effect and magnetoresistance of solid solutions in the AlSb—InSb system from 80 to 1000°K. From these properties the forbidden band widths, carrier densities and mobilities were obtained. A.Tybulewicz

539.2 : 537.311

15944 THE EFFECT OF IMPURITIES ON ELECTRICAL CONDUCTION IN VITREOUS As_2SeTe_2.
B.T.Kolomiets and T.F.Nazarova.
Fiz. tverdogo Tela, Vol. 2, No. 1, 174-6 (Jan., 1960). In Russian.

Zone purification of As_2SeTe_2 ($As_2Se_3.2As_2Te_3$) left the electrical conductivity (σ) of a vitreous material practically unaffected ($\sim 10^{-6}$ ohm^{-1} cm^{-1}, p-type) but lowered considerably σ of crystals (it fell from 60 to ~ 0.01 ohm^{-1} cm^{-1}) and altered it from p- to n-type. This suggests that impurity conduction is important in crystals but not in vitreous material. A.Tybulewicz

539.2 : 537.311

15945 BONDING AND SEMICONDUCTIVITY RELATIONSHIPS IN Bi_2Te_3 AND CdI_2 TYPE STRUCTURES.
G.H.L.Goodman.
J. Electrochem. Soc., Vol. 107, No. 6, 564-5 (June, 1960).

Indicates a possible bonding scheme for the 3 layer CdI_2 structure which is related to a bonding scheme previously suggested for Bi_2Te_3 (Abstr. 3461 of 1959). R.Bullough

539.2 : 537.311

15946 ANISOTROPY OF ELECTRICAL PROPERTIES OF CADMIUM ANTIMONIDE MONOCRYSTALS.
I.K.Andronik and M.V.Kot.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1128-33 (June, 1960). In Russian.

CdSb monocrystals were grown using a modified Bridgman's method or zone recrystallization. Measurements of the electrical conductivity, Hall constant, magnetoresistance and thermoelectric power between liquid-oxygen temperature and 150°C showed that these properties and the hole mobility are anisotropic. The forbidden band width was about 0.57 eV. A.Tybulewicz

539.2 : 537.311

15947 STRUCTURE OF THE ENERGY BANDS IN SEMICONDUCTORS OF THE $CdIn_2Se_4$ TYPE.
A.I.Gubanov and F.M.Gashimzade.
Fiz. tverdogo Tela, Vol. 2, No. 2, 255-60 (Feb., 1960). In Russian.

The method of localized valency is used. The form of E(k) near the energy extremals for k = 0 is calculated by perturbation theory. Spin—orbit coupling is then included to the first order. In view of the lack of experimental data, the possible forms of the equipotential surfaces near the extremals are enumerated, taking account of spin. R.Berman

539.2 : 537.311

15948 PROPERTIES OF P—N JUNCTIONS IN CADMIUM TELLURIDE PHOTOCELLS.
Yu.A.Vodakov, G.A.Lomakina, G.P.Naumov and Yu.P.Maslakovets.
Fiz. tverdogo Tela, Vol. 2, No. 1, 15-22 (Jan., 1960). In Russian.

The characteristics of several photocells were measured and agreement obtained with Shockley's theory which allows for recombination at the junction. In some, deviations from the theory and low efficiencies were found at low illuminations due to non-uniformities at the junctions, which were near the surface. The weak temperature dependence of I_0 and other measurements indicated that tunnelling occurs in the narrow regions of the junctions. In the better photocells efficiencies greater than 4% were obtained in sunlight. D.J.Huntley

539.2 : 537.

15949 THE MECHANISM OF PHOTOCONDUCTIVITY IN AMORPHOUS CHALCOGENIDE LAYERS.
B.T.Kolomiets and V.M.Lyubin.
Fiz. tverdogo Tela, Vol. 2, No. 1, 52-4 (Jan., 1960). In Russian.

The luxampere characteristics and temperature dependence were measured in amorphous layers of Sb_2S_3 and As_2Se_3. The photocurrent was found to be proportional to E^n, where E is the illumination intensity and n = 0.5 - 0.6. For small values of E a change to n = 0.9 - 1.0 was found and ascribed to the existence of two types of recombination. The photocurrent was found first to increase, due to increase of mobility, and then to decrease, due to increase of recombination, with temperature. The former was used to estimate the energy of the traps as 0.3 e
D.J.Huntl

539.2 : 537.3

15950 ELECTRICAL PROPERTIES OF COBALT AND NICKE OXIDE SEMICONDUCTING MIXTURES.
B.T.Kolomiets, I.T.Sheftel', E.V.Kurlina and G.N.Tekster-Proskuryakova.
Fiz. tverdogo Tela, Sbornik [Supplement] II, 50-62 (1959). In Russ

Reports a study of the electrical properties of CoO—NiO—O_2 mixtures prepared from cobalt and nickel oxide hydrates by heatin in air at 950 or 1200°C. The electrical conductivity depended strongly on the initial composition, on the additional heat treatmen at 600 or 800°C and on the ambient medium (oxygen, hydrogen, nitrogen with argon, vacuum) of this last treatment. The results indicated low thermal stability of the CoO—NiO—O_2 materials.
A.Tybulewi

539.2 : 537.3

15951 TEMPERATURE DEPENDENCE OF THE ELECTRICA CONDUCTIVITY OF DIAMONDS. K.N.Pogodaev.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1450-6 (July, 1960). In Russian

The electrical conductivity (δ) of transparent Yakutsk diamon in natural and X-ray irradiated forms was investigated between 50° and 350°C. Above 220°C the temperature dependence of δ of a samples was exponential; up to two maxima of δ (at 110° and 180°(were observed in X-ray irradiated samples. It was concluded tha conduction is n-type at lower temperatures and p-type at higher temperatures. A.Tybulewi

539.2 : 537.3

15952 THE ENERGY SPECTRUM OF HOLES IN DIAMOND-TYPE CRYSTALS. K.Ya.Shtivel'man.
Fiz. tverdogo Tela, Vol. 2, No. 4, 644-50 (April, 1960). In Russia

Describes a calculation of the energy spectrum of holes in p-germanium and p-silicon. The calculation uses the method of Samoilovich and Tovstyuk (Abstr. 1438 of 1959), modified by allow ance for the spin—orbit interaction and the effect of the nearest neighbours in further coordination spheres. The expressions for t hole energies are obtained for a wide range of quasi-momenta. Se also Abstr. 11597 of 1960. A.Tybulewi

539.2 : 537.3

15953 THE EFFECT OF CERTAIN SEMICONDUCTOR SURFACE PROPERTIES ON THE REACTION OF XANTHATE WITH GALENA. I.N.Plaksin and R.Sh. Shafeev.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 399-401 (May 11, 1960). In Russian.

A short discussion of the surface electrical properties of an extrinsic semiconductor with which adsorbed oxygen acts as an acceptor. It is suggested that xanthate can bond readily only to a p-type surface. The latter may be formed on n-type material through oxygen adsorption. A thermoelectric probe apparatus is described and measurements of thermo e.m.f. to 400°C are briefl reported for galena, chalcopyrite, molybdenite and pyrites. The first two were n-type, the others p-type. C.H.L.Goodma

539.2 : 537.31

15954 THERMOMAGNETIC PROPERTIES OF GALLIUM ANTIMONODE. D.Kh.Amirkhanova.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1125-7 (June, 1960). In Russian.

The results of measurements, carried out at 150-950°K on 5 p-type GaSb specimens, are reproduced in the form of graphs, showing the temperature dependence of the Hall constant, mobility, thermo-e.m.f., and Nernst-Ettinghausen effect. All the specimens studied were characterized by the negative sign of the Nernst—Ettinghausen effect whose magnitude decreased with rising temper ture, reaching a minimum at approximately 700°K. M.H.Slobod

539.2 : 537.311

955 THE ELECTRICAL CONDUCTIVITY OF GALLIUM ARSENOSELENIDES AT HIGH TEMPERATURES.

Nasledov and I.A.Feltin'sh.

z. tverdogo Tela, Vol. 2, No. 5, 823-5 (May, 1960). In Russian.

Reports temperatures dependences (up to 1000° K) of the e rical conductivity, Hall constant and thermoelectric power As—Ga_2Se_3 samples with various proportions of the two com- nts. From these properties the carrier density and mobility, heir temperature dependences, were obtained. The forbidden width was 1.40 eV for $7GaAs.Ga_2Se_3$ rising to 1.98 eV for pure $_3$. A.Tybulewicz

539.2 : 537.311

956 GALVANOMAGNETIC EFFECTS IN N-TYPE InSb IN MAGNETIC PULSED FIELDS.

.Amirkhanov, R.I.Bashirov and Yu.É.Zakiev.

. Akad. Nauk SSSR, Vol. 132, No. 4, 793-6 (June 1, 1960). ussian.

Galvanomagnetic measurements on n-type InSb were made in ed magnetic fields of up to 800 kilogauss. Graphs are given of netoresistance and Hall constant against magnetic field at 77° K, of magnetoresistance against temperature at 340 kilogauss. The temperature Hall constant was found to saturate at 400 kilogauss. parison with theory (Abstr. 5741 of 1959) suggested that both ce and impurity scattering must be considered. The field ndence of galvanomagnetic effects was observed also in n-type e and InAs, but no data are given here. I.D.C.Gurney

539.2 : 537.311

5957 ELECTRICAL AND MAGNETOELECTRIC PROPERTIES OF P-TYPE INDIUM ANTIMONIDE.

Volokobinskaya, V.V.Galavanov and D.N.Nasledov.

. tverdogo Tela, Sbornik [Supplement] I, 122-9 (1959). ussian.

Reports an investigation of (1) the temperature dependences of Hall constant, electrical conductivity and magnetoresistance at peratures from 77° to 300° K in fields of 500-8500 Oe; and (2) field dependences (H = 100-10 000 Oe) of the Hall constant and gnetoresistance at 77° and 300° K. The samples were mono- and crystals of p-InSb prepared by zone melting. The results ained agreed only partially with the current theory of magneto- ctric properties. A.Tybulewicz

539.2 : 537.311

15958 THE INFLUENCE OF ELECTRIC FIELDS ON THE ELECTRICAL CONDUCTIVITY, HALL COEFFICIENT D MAGNETORESISTANCE OF N-TYPE InSb AT LOW TEMPERA- RES.

Lyan' Chzhi-chao [Lien Chih-ch'ao] and D.N.Nasledov.

. tverdogo Tela, Vol. 2, No. 5, 793-8 (May, 1960). In Russian.

Dependence of the electrical conductivity (σ), Hall constant (R), l magnetoresistance on the electric field (E) was measured in ype InSb with 10^{12}-10^{14} cm^{-3} impurities at 2-78° K. The initial rease of σ and R was deduced to be caused by tunnelling of elec- ns from the impurity band to the conduction band; in this way the ctric field excites the electrons similarly to temperature and, ce the energy gap is ~ 6 × 10^{-4} eV, no variation of σ with E was served at 78° K. The variation of σ and R with E was explained assuming different mobilities for the electrons in the conduction l impurity bands. The dependence of magnetoresistance on the ld was not understood. D.J.Huntley

539.2 : 537.311

15959 ELECTRICAL PROPERTIES OF THE EQUIMOLECULAR ALLOY InSb.GaSb.

V.I.Ivanov-Omskii and B.T.Kolomiets.

z. tverdogo Tela, Vol. 2, No. 3, 388-94 (March, 1960). In Russian.

Reports the temperature dependences (77-500° K) of the electrical nductivity, Hall constant, thermoelectric power, transverse and longi- dinal Nernst—Ettingshausen coefficients. The hole and electron obilities at room temperature were ~600 and 30 000 $cm^2 V^{-1} sec^{-1}$ spectively. The forbidden band width was 0.42 eV at ~0° K and 33 eV at room temperature. The effective electron and hole asses were found to be 0.04 and 0.25 m_0 respectively.

A.Tybulewicz

539.2 : 537.311

15960 GROWN P—N JUNCTIONS IN SILICON CARBIDE.

C.A.A.J.Greebe and W.F.Knippenberg.

hilips Res. Rep., Vol. 15, No. 2, 120-3 (April, 1960).

An account is given of the preparation and properties of grown junctions. The forward characteristics are tentatively explained on the basis of a p—i—n structure. p—n luminescence has been observed containing violet light.

539.2 : 537.311 : 535.33

ENERGY GAP IN β-SiC. See Abstr. 16062

539.2 : 537.311

15961 SEMICONDUCTING PROPERTIES OF THE $AgFeTe_2$ PHASE.

E.L.Shtrum.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1489-93 (July, 1960). In Russian.

Metallographic and X-ray diffraction studies showed that $AgFeTe_2$ undergoes two phase transitions (at 150 and 520° C) and that it is single-phased within a range of compositions departing up to 4 at.% from stoichiometry. Within this range the compound is a semiconductor, as shown by measurements of its electrical conductivity and thermoelectric power. A.Tybulewicz

539.2 : 537.311

15962 P-I-N JUNCTION IN THE ANODIC OXIDE FILM OF TANTALUM.

Y.Sasaki.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 177-86 (June, 1960).

For the purpose of clarifying the structure of anodic oxide film of tantalum, photo-effects and variation of capacity with applied bias potential were studied for relatively thin anodic oxide films. From the results it is concluded that a p-i-n junction is formed in the oxide film. The construction of junction is as follows. In contact with the base metal there are very thin n-layers, and on the layers there lie nearly stoichiometric i-layers. The surface p-layers lying above i-layers are also very thin. The thickness of the i-layers is proportional to the anodization voltage, and the thickness of the extrinsic layers is nearly independent of the anodization voltage and may be in the range of 20-50 A. The donor levels consist of excess tantalum atoms and the acceptor levels consist of excess oxygen atoms (or defects of tantalum atoms) as well as adsorbed oxygen on the oxide surface. Due to nearly amorphous structure of the oxide, the recombination rate of injected carriers is high in the junction. Coincidence between the theory of p-i-n junction and the experimental results is quite good.

539.2 : 537.311

15963 THE TEMPERATURE DEPENDENCE OF LOW-FREQUENCY FLUCTUATIONS OF CONDUCTIVITY IN TELLURIUM.

M.I.Kornfel'd and D.N.Mirlin.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 251-7 (1959). In Russian.

Reports an investigation of conductivity fluctuations during the passage of currents of up to 10 kc/s frequency, at temperatures between 77° and 340° K. There was no explicit dependence of the intensity of the fluctuations on temperature, but the intensity did depend on the carrier density. A.Tybulewicz

539.2 : 537.311

15964 THE HALL EFFECT IN VITREOUS MATERIALS OF THE $Tl_2Se.As_2(Se, Te)_3$ SYSTEM. II.

B.T.Kolomiets and T.F.Nazarova.

Fiz. tverdogo Tela, Vol. 2, No. 3, 395-6 (March, 1960). In Russian.

The Hall constant was measured in samples of 10^{-3}-10^{-9} $ohm^{-1} cm^{-1}$ conductivity. From it the "carrier mobility" was deduced to be about 0.01 $cm^2 V^{-1} sec^{-1}$ (it is pointed out that the concept of "carrier mobility" in vitreous semiconductors is far from clear). The "mobility" was independent of the amount of Te(0-100%). It was concluded that the rise of the electrical conductivity with increase of the Te content was due to a parallel rise of the carrier density. See also Abstr. 11706 of 1960. A.Tybulewicz

539.2 : 537.311

15965 SEMICONDUCTING TIN DIOXIDE.

A.Ya. Kuznetsov.

Fiz. tverdogo Tela, Vol. 2, No. 1, 35-42 (Jan., 1960). In Russian.

Describes methods of preparation of semiconducting SnO_2 films and massive samples with σ = 3000 $ohm^{-1} cm^{-1}$ and discusses their optical (transmission coefficient and refractive index) and electrical properties (electrical conductivity, Hall constant, carrier density and mobility). A.Tybulewicz

539.2 : 537.311

15966 ANISOTROPIC CONDUCTION IN NONSTOICHIOMETRIC RUTILE (TiO_2).

L.E.Hollander, Jr and P.L.Castro.

Phys. Rev., Vol. 119, No. 6, 1882-5 (Sept. 15, 1960).

Measurements are reported for the anisotropic conductivity in rutile for different nonstoichiometric compositions. This anisotropy ρ_a/ρ_c, has a peak in excess of 10 000 to 1 and is a maximum at the nonstoichiometric composition corresponding to $\rho_c = 10^3$ ohm cm. Based on these data, it is proposed that for very nonstoichiometric material, impurity band conduction predominates, and as the material is made more stoichiometric, a transition to conventional conduction via the conduction band occurs. This transition occurs at very different nonstoichiometric compositions for the two crystal directions. Thus, a large anisotropy is observed in the intermediate region.

539.2 : 537.311

15967 ANISOTROPY OF SOME ELECTRICAL PROPERTIES OF ZINC ANTIMONIDE MONOCRYSTALS.

M.V.Kot and I.V.Kretsu.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1250-5 (June, 1960). In Russian.

The electrical conductivity, Hall effect and thermoelectric power were measured in three mutually perpendicular directions in single crystals of ZnSb between 100 and 500° K. They, as well as the hole mobility, were found to be different in the different directions. The width of the energy gap was deduced from the Hall effect to be 0.6 eV. D.J.Huntley

539.2 : 537.311

15968 INVESTIGATION OF THE CONDUCTIVITY INDUCED [BY ELECTRON BOMBARDMENT] IN THIN LAYERS OF ZINC SULPHIDE.

A.A.Didenko, Yu.A.Nemilov and V.I.Fomina.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1434-40 (July, 1960). In Russian.

Investigations of the electrical conductivity induced by electron bombardment in thin vacuum-deposited ZnS layers showed that the "dark" conductivity and the amplification factor (increase of current due to electron bombardment) both depended on the polarity and magnitude of the voltage applied across such layers. The amplification factor depended on the energy and density of electrons in the exciting beam in the same way as in other semiconductors (Abstr. 2507 of 1949; 7986 of 1950; 5412 of 1951). The maximum amplification factor of ZnS layers did not exceed 320. A.Tybulewicz

539.2 : 537.311

15969 ORGANIC SEMICONDUCTORS. II. THE ELECTRICAL RESISTIVITY OF ORGANIC MOLECULAR COMPLEXES.

M.M.Labes, R.Sehr and M.Bose.
J. chem. Phys., Vol. 33, No. 3, 868-72 (Sept., 1960).

For Pt I, see Abstr. 13621 of 1960. Thirty molecular complexes involving quinones, halogens, polynitroaromatics, or tetracyanoethylene as electron acceptors and aromatic hydrocarbons or substituted aromatics as electron donors were prepared and the room-temperature electrical resistivities measured on compressed microcrystalline material. A lowering of electrical resistivity is generally associated with complex formation. The results are discussed in terms of crystal structure and charge transfer complex theory.

539.2 : 537.311 : 532.7

15970 THE SEMICONDUCTING PROPERTIES OF SERUM ALBUMIN. P.Douzou and J.M.Thuillier.

J. chem. Phys., Vol. 57, No. 2, 96-100 (Feb., 1960). In French.

Measurements were made of the low-temperature phosphorescence, resistivity, photoconductivity and surface effects of crystals and solutions of serum albumin. The results are discussed in relation to the general question of semiconductivity and energy transfer in proteins. J.B.Birks

539.2 : 537.311 : 621.382.2

15971 ON THE CURRENT RATIO I MAX/I MIN OF TUNNEL DIODES. M.Michelitsch.

Naturwissenschaften, Vol. 47, No. 12, 274 (1960). In German.

The peak—valley current ratio is found to be very dependent on the time taken to alloy the junction. C.Fromberg

539.2 : 537.311 : 621.382.2

15972 DETERMINATION OF THE IMPURITY DISTRIBUTION IN JUNCTION DIODES FROM CAPACITANCE—VOLTAGE MEASUREMENTS. J.Hilibrand and R.D.Gold.

R.C.A. Rev., Vol. 21, No. 2, 245-52 (June, 1960).

To be useful, the impurity density level should be accurate to better than 20% and the impurity profile should be even more accurate. A method for the measurement of impurity distributions to the required degree of accuracy is described.

539.2 : 537.311 : 621.382

15973 THE EFFECT OF HEAT TREATMENT AND ION BOMBARDMENT ON THE PROPERTIES OF SILICON POINT-CONTACT DIODES. I.D.Kirvalidze and S.G.Chernyavska

Fiz. tverdogo Tela, Sbornik [Supplement] I, 155-8 (1959). In Rus

Both heat treatment in air (10 hours at 1250° C) and ion bomb ment (7 hours) in a glow discharge in argon improved at least o of the following characteristics of p-type diodes: breakdown volta forward resistance, reverse resistance. The improved propert of p-type diodes were retained up to 400° C. No improvement wa produced by the glow-discharge treatment in the case of n-type diodes. A.Tybulew

539.2 : 537.311 : 621.382

15974 POINT-CONTACT GALLIUM ARSENIDE DIODES. D.N.Nasledov, N.N.Smirnova and B.V.Tsarenkov.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 96-8 (1959). In Russ

Describes preparation of point-contact diodes made of n-GaA Gives current—voltage characteristics at temperatures from 25 300° C and shows that rectifying properties are retained up to 300 A.Tybulew

539.2 : 537.311 : 621.382

15975 INVESTIGATION OF CHARACTERISTICS OF GERMANIUM DIODES.

I.M.Senderikhin and P.V.Sharavskii.
Fiz. tverdogo Tela, Vol. 2, No, 7, 1497-1505 (July, 1960). In Russ

Reports a study of static and pulse voltage—current characte istics and of thermal breakdown of germanium thermistors and rectifiers. See also following abstract. A.Tybulew

539.2 : 537.311 : 621.382

15976 THEORY OF THE THERMAL BREAKDOWN OF GERMANIUM DIODES. I.M.Senderikhin.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1506-17 (July, 1960). In Russia

Inverse voltage—current characteristics of germanium point-contact and junction diodes are discussed within the framework of the thermal breakdown theory. A qualitative agreement is report between the experimental results (see preceding abstract) and the in the case of an impurity semiconductor. A.Tybulew

539.2 : 537.311 : 621.382.2

15977 TURN-ON TRANSIENT OF P—N—P—N TRIODE. T.Misawa.

J. Electronics and Control, Vol. 7, No. 6, 523-33 (Dec., 1959).

The turn-on transient of the p—n—p—n switch is analysed wit simplifying assumptions. Experiments on the silicon p—n—p—n power triode show that two mechanisms determine the current waveform during the transient. Before the centre junction becom forward biased (switches on), the current increases nearly (or faster than) exponentially. After switch-on, the p—n—p—n switch behaves as an inductive impedance and the increase rate of curre decreases. This is ascribed to the gradual modulation of conductivity of a base region of high resistance. Analytical expression is derived for the relation between base current and delay time when the step current is applied to the base.

539.2 : 537.3

15978 PROPERTIES OF GERMANIUM TRANSISTORS MADE DOUBLE DIFFUSION. R.Deschamps.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4307-9 (June 27, 1960). In French.

Transistors have been made by a technique previously descri (Abstr. 11686 of 1960). The values observed for base resistance a breakdown voltage are in good agreement with theoretical predicti A method is given for measuring the transistor parameters at hig frequency. C.Hilsu

539.2 : 537.311 : 621.382.3

15979 ELECTRIC FIELD IN THE BASE OF A JUNCTION TRANSISTOR AT LOW INJECTION LEVELS.

Yu.S.Ryabinkin.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 159-69 (1959). In Russian.

An expression was obtained for the electric field distribution in the quasi-neutral region in the base of a junction transistor at low injection levels. Solution of the fundamental equations of the transistor theory was discussed for various relationships between diffusion, recombination and the field. The region of applicability of the diffusion—recombination theory of Shockley was found. Dependence of the emitter—collector transmission factor on the

r current was found to agree well with experiment at low
on levels. It was found that in high-frequency transistors the
of the field dominates the effect of recombination even at low
on levels. An expression was found for the current—voltage
cteristics and for the distribution of minority carriers in the
f the transistor.

539.2 : 537.311 : 621.382.333

1 80 ON THE DETERMINATION OF THE MINORITY CARRIER LIFETIME IN THE BASE REGION OF TRANSISTORS.

as and A.R.Boothroyd.
ctronics and Control, Vol. 7, No. 6, 534-9 (Dec., 1959).

method of determining the lifetime of minority carriers in the
egion of a uniform base transistor is presented. This involves
rement of the base-width modulation parameters and the base
ort time, taking into account effects of all extrinsic properties
transistor. The technique of measurement also leads to a
method of determining the extrinsic base resistance and
tor capacitance.

conductivity

539.2 : 537.312

981 THE PHOTOMAGNETIC EFFECT IN ISOTROPIC SEMICONDUCTORS AND ITS USE IN MEASURING THE TIME OF MINORITY CURRENT CARRIERS. A.A.Grinberg.

verdogo Tela, Vol. 2, No. 5, 836-47 (May, 1960). In Russian.

he kinetic equation with an arbitrary dependence of the relaxa-
ime on energy is used to deduce a convenient form of the cur-
equation in the case of two types of carrier of the same sign
s). The latter equation is used to obtain photocurrents and
magnetic e.m.f.'s in arbitrary magnetic fields within the limits
lidity of the classical kinetic equation. The photomagnetic
od of measuring the carrier lifetime is discussed and formulae
educed for determination of the lifetime in strong fields. It is
n that deviation from the usual lifetime formula for an impurity
le with a relaxation time independent of energy becomes very
at $H \cong 10^{-8}/\sqrt{\mu_n \mu_p}$ Oe (μ_n and μ_p are the microscopic mobili-
of electrons and holes, respectively). A.Tybulewicz

539.2 : 537.312

5982 THEORY OF THE PHOTOMAGNETIC EFFECT IN ANISOTROPIC CUBIC CRYSTALS. A.A.Grinberg.

tverdogo Tela, Vol. 2, No. 7, 1361-7 (July, 1960). In Russian.

Develops a theory of the photoelectromagnetic effect for
tropic cubic crystals in weak magnetic fields and with arbitrary
tation of the crystal with respect to the directions of illumina-
and the magnetic field. A.Tybulewicz

539.2 : 537.312

15983 CONDITIONS REQUIRED FOR APPEARANCE OF "γ-CONDUCTIVITY" IN CdS MONOCRYSTALS.

Konozenko, V.I.Ust'yanov and A.P.Galushka.
tverdogo Tela, Vol. 2, No. 7, 1584-91 (July, 1960). In Russian.

It was found that γ-ray-induced electrical conductivity of CdS
ocrystals is closely related to the presence of local centres of
shallow trap type (ΔE_1 = 0.08-0.14 eV). In the absence of such
s irradiation with Co^{60} γ-rays about 3000 μr/sec intensity did
produce any noticeable "γ-conductivity" (the change of current
unted to 10^{-13} A). It is suggested that Compton electrons, pro-
ed on scattering of γ-rays, transfer current carriers from band
and and act upon excitons and electrons in the inner shells of
and S atoms. In the presence of shallow traps, excitons de-
pose at negatively charged centres and electrons are subse-
ntly transferred to the conduction band. A.Tybulewicz

539.2 : 537.312

5984 THE EFFECT OF MECHANICAL SURFACE TREATMENT ON THE FINE STRUCTURE OF THE SPECTRAL SPONSE OF THE PHOTOCONDUCTIVITY OF CADMIUM LPHIDE CRYSTALS [AT 77°K]. E.F.Gross and B.V.Novikov.

. tverdogo Tela, Vol. 1, No. 12, 1882-5 (Dec., 1959). In Russian.

Even a gentle surface treatment (polishing with wet silk)
duced self-reversal and false photocurrent maxima. On increasing
severity of the surface treatment, a false maximum at long
elengths was found to be broadened and displaced (towards longer
elengths), the photocurrent became much weaker in the short-
elength region and the total photosensitivity fell. A.Tybulewicz

539.2 : 537.312

15985 INVESTIGATION OF THE KINETICS OF INFRARED IMPURITY PHOTOCONDUCTIVITY IN CdS, INDUCED BY PRELIMINARY ILLUMINATION.

E.N.Arkad'eva, L.G.Paritskii and S.M.Ryvkin.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1160-8 (June, 1960). In Russian.

Preliminary illumination with light in the fundamental absorption region produced photoconductivity in CdS monocrystals in the 2-4 μ region at 77°K. This photoconductivity was assumed to be due to transitions of electrons from trapping levels to the conduction band; the preliminary illumination filled these trapping levels. An appropriate theory was worked out and the following quantities were deduced: the capture cross-section of a photon by a charged centre; the i.r. absorption coefficient; populations, densities and positions of the trapping levels; the capture cross-section of a conduction-band electron by these levels. A.Tybulewicz

539.2 : 537.312

15986 THE ELECTRICAL CONDUCTIVITY AND PHOTOELECTRIC PROPERTIES OF CADMIUM AND ZINC TELLURIDE FILMS. P.P.Konorov and I.B.Shevchenko.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1134-40 (June, 1960). In Russian.

CdTe and ZnTe films were prepared by vacuum deposition and their dark and photoconductivities were investigated. Properties of CdTe films did not differ from those of massive polycrystalline or monocrystalline samples. Heating of CdTe films of 1μ thickness at 350-400°C in air or in vacuum produced high photosensitivity in the visible and near infrared regions. ZnTe films had low photosensitivities both after preparation and after subsequent heating at 250-300°C. A.Tybulewicz

539.2 : 537.312

15987 THE QUANTUM YIELD OF P—N JUNCTION CdTe PHOTOCELLS IN THE ULTRAVIOLET REGION.

G.B.Dubrovskii.
Fix. tverdogo Tela, Vol. 2, No. 4, 569-70 (April, 1960). In Russian.

The quantum yield of these photocells (produced by diffusion of gold) rose at photon energies of 3.5-5.0 eV, i.e. at energies greater than $2E_g$ (E_g = 1.45 eV for CdTe) carrier multiplication occurred. A.Tybulewicz

539.2 : 537.312

15988 THE EFFECT OF SIMULTANEOUS ACTION OF LIGHT OF VARIOUS WAVELENGTHS ON THE NEGATIVE AND POSITIVE PHOTOCONDUCTIVITIES OF CUPRITE.

A.N.Krongauz, V.K.Lyapidevskii and Yu.S.Deev.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 130-2 (1959). In Russian.

Natural cuprite crystals were illuminated simultaneously with red light (6000 A), which by itself reduced the conductivity ("negative photoconductivity"), and with blue light, which by itself increased the conductivity ("positive photoconductivity"). The observed complex effects were found to depend on the intensities of the two illuminations and on preliminary excitation. The sequence (1) red illumination, followed by (2) red + blue illumination, produced non-additive effects; the sequence (1) blue, (2) blue + red, produced additive effects. A.Tybulewicz

539.2 : 537.312

15989 PHOTOCONDUCTIVITY IN GALLIUM SULFOSELENIDE SOLID SOLUTIONS. R.H.Bube and E.L.Lind.

Phys. Rev., Vol. 119, No. 5, 1535-7 (Sept. 1, 1960).

The photoconductivity characteristics of solid solutions of GaSe and GaS were investigated for proportions of GaS between 10 and 50%. The difference between the room temperature band gaps of GaSe and GaSe(50)·GaS(50) is 73% of the total difference between the band gaps of GaSe (2.03 eV) and GaS (2.58 eV). The optical quenching energy and the thermal quenching energy of sensitizing centres are independent of the solid solution composition, thus giving additional evidence that these centres are associated with the crystal cation and that the photoconductivity observed is associated with holes.

539.2 : 537.312

15990 THE EFFECT OF SURFACE TREATMENT ON THE SPECTRAL RESPONSE OF THE PHOTOCONDUCTIVITY OF N- AND P-GERMANIUM. V.A.Petrusevich.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 56-62 (1959). In Russian.

It was found that surface treatments affect strongly the spectral response of steady-state photoconductivity and the reflection coefficient. A quantitative relationship was established between the velocity of surface recombination and the form of the spectral photoconductivity response. A.Tybulewicz

539.2 : 537.312

15991 SOME ELECTRICAL PROPERTIES OF AMORPHOUS SELENIUM FILMS.

R.A.Fotland.

J. appl. Phys., Vol. 31, No. 9, 1558-65 (Sept., 1960).

The dark current and photocurrent characteristics of amorphous selenium and arsenic—selenium alloy films have been investigated. One millisecond after the application of an electric field, the dark current (neglecting capacitance charging) is several orders of magnitude higher than the steady-state dark current. A hysteresis effect is observed in the dark V—A curves with the descending voltage branch exhibiting an exponential V—A relationship. The voltage of a charged Se plate in the dark discharges logarithmically with time as anticipated from the exponential V—A relationship. Upon admitting air to a freshly evaporated Se plate, a negative surface potential of 150 mV is observed. The phenomenon of "fatigue" (i.e., the temporary increase in dark current following an exposure to illumination) obtained with highly absorbed radiation indicates surface barrier effects exert a large measure of control over dark currents. Photogenerated holes and electrons in Se films are trapped with trapping parameters such that the hole range/unit field is of the order of 10^{-8} cm^2/V, and the electron range is less than 10^{-9} cm^3/V. The addition of As to the Se greatly increases the electron effective lifetime. Trapped holes are eliminated in the dark exponentially with time through a process having an activation energy of 0.77 eV. A 40 mV negative surface photovoltage is observed in Se films upon illumination. This voltage may be accounted for by hole diffusion away from the surface. The addition of As to Se extends the spectral response into the red end of the spectrum, results in the initiation of secondary photocurrent effects, intensifies fatigue effects, and increases the softening temperature of the film.

539.2 : 537.312

15992 THE EFFECT OF PRESSURE ON THE SIGN OF PHOTOCURRENT THROUGH A CONTACT OF A METAL POINT WITH A SEMICONDUCTOR.

I.D.Kirvalidze.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 76-7 (1959). In Russian.

On increasing the pressure on a metal needle in contact with p-type Si or Ge, the photocurrent through this contact rose, reached a maximum, fell to zero and finally reversed its sign. The absolute value of the reverse photocurrent continued to rise with further increase of pressure. The phenomenon was fully reversible up to pressures of 10^4-10^5 kg/cm^2 when mechanical damage occurred. In the case of n-type Si or Ge the contact pressure did not affect the sign of the photocurrent. A short discussion of the results is given.

A.Tybulewicz

539.2 : 537.312

15993 THE PROCESS OF PHOTO-IONIZATION IN SILICON.

K.I.Britsyn and V.S.Vavilov.

Optika i Spektrosk., Vol. 8, No. 6, 861-7 (June, 1960). In Russian.

Reports a study of the wavelength and temperature dependences of the quantum yield (number of electron—hole pairs generated by one photon) of photons with energies up to 4.9 eV absorbed in silicon. It was found that the quantum yield depends on temperature only in the region where collision ionization is produced by photon-liberated carriers. On increasing the temperature, the collision-ionization region is shifted towards lower photon energies, which is partly due to the reduction of the forbidden bandwidth in silicon.

A.Tybulewicz

539.2 : 537.312

15994 ELECTRON MOBILITY AND SCATTERING PROCESSES IN AgBr AT LOW TEMPERATURES.

D.C.Burnham, F.C.Brown and R.S.Knox.

Phys. Rev., Vol. 119, No. 5, 1560-70 (Sept. 1, 1960).

The Hall effect for electrons released by light in high-purity crystals of AgBr was studied experimentally in the temperature range 4° to 120°K. The observed mobilities exceed 20 000 cm^2/V sec at very low temperatures. The general features of the dependence of low-field Hall mobility on temperature can be understood by comparison with standard theory. A nearly exponential dependence of mobility on 1/T is observed from 40° to 120° K, as predicted for scattering by optical vibrations of the lattice. The slope of the (log μ) versus 1/T data agrees quite well with the Debye Θ for the longitudinal optical mode as deduced from reststrahlen data. Below 40°K the observed mobilities can be explained in terms of a combination of the effects of optical, acoustical and charged impurity scattering. The last process appears to dominate below 15°K. High-field effects are observed which can be explained by classical transport theory assuming a conduction band of standard form as well as isotropic scattering.

539.2 : 537

15995 THE HIGH-VOLTAGE PHOTOEFFECT IN ZnS SING CRYSTALS.

J.Tauc.

J. Phys. Chem. Solids, Vol. 11, No. 3-4, 345-6 (Oct., 1959).

A model is proposed to account for the high-voltage photoeff in ZnS single crystals.

C.D.

539.2 : 537

15996 SPECTRAL RESPONSE OF THE INTERNAL PHOTO EFFECT IN THE ZnSe—CdSe SYSTEM.

B.T.Kolomiets and Lin' Tszyun'-tin [Lin Chün-t'ing].

Fiz. tverdogo Tela, Vol. 2, No. 1, 168-70 (Jan., 1960). In Russia

Four samples had sphalerite structure (ZnSe, 4ZnSe.CdSe, 2ZnSe.CdSe, ZnSe.CdSe) and four were of wurtzite type (ZnSe.2C ZnSe.3CdSe, ZnSe.4CdSe, CdSe). Photoconductivity response spe were obtained in the λ = 460-780 mμ region for all these samples and the forbidden bandwidths (ΔE) were deduced. The value of Δ fell monotonically from ~ 2.6 eV for ZnSe to ~ 1.7 eV for CdSe.

A.Tybulew

539.2 : 537.312 :

OPTICAL AND PHOTO-ELECTRIC PROPERTIES OF ZINC SELENIDE AND TELLURIDE. See Abstr. 13671

539.2 : 537

15997 HOLE AND ELECTRON DRIFT MOBILITIES IN ANTHRACENE.

O.H.LeBlanc, Jr.

J. chem. Phys., Vol. 33, No. 2, 626 (Aug., 1960).

Using a spark source (pulses < 1 μsec) the photocurrent transients are measured in a single crystal. Carriers are prod within 10^{-3} cm of one electrode. Delay in onset of photocurrent decay is attributed to the slow drift of positive holes to the catho (drift mobility estimate 0.5-1 cm^2/volt sec at 25°C).

G.F.J.Gar

Thermoelectric Properties

539.2 : 537.32 : 5

15998 THE EFFECT OF THE DEFORMATION TEMPERAT ON THE VARIATION OF MICROHARDNESS AND DEFORMATION-INDUCED THERMO-E.M.F.

N.F.Kunin and A.Ya.Usov.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 115-18 (1960). In Russian.

Room-temperature measurements of thermo-e.m.f., E, due plastic deformation and microhardness, H, were carried out on specimens, deformed plastically between -183 and +100°C. Both E and H were proportional to the degree of deformation and decr exponentially with increasing deformation temperature, the expo tial constant being the same in both cases.

M.H.Slob

539.2 : 537.32 : 5

15999 THE DYNAMIC EFFECT OF THE [PLASTIC-DEFORMATION] INDUCED THERMO-E.M.F. OF COPPER, ALUMINIUM, AND MILD STEEL.

N.F.Kunin and L.I.Afanas'yeva.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 24-7 (1960). In Russian.

It has been shown previously by Kunin and Karelin that the m tude of the thermo-e.m.f. between plastically deformed and anne Cu depends not only on the degree, but also on the rate of deform This "dynamic effect" of the deformation-induced thermo-e.m.f. studied on Cu, Al, and mild-steel specimens, deformed statically dynamically. The coefficient of the dynamic effect, defined as $k = e_a/e_{st}$, where e_a and e_{st} are the thermo-e.m.f. due to dynami and static deformation, respectively, decreased with increasing gree of deformation. It was observed that the lower the melting point of the metal studied, the higher the value of k correspondin a given degree of deformation.

M.H.Slob

539.2 : 53

16000 INVERSION OF THE THERMOELECTRIC POWER IN THE REGION OF WELDED CONTACTS BETWEEN METALS.

L.N.Érastov.

Fiz. tverdogo Tela, Vol. 2, No. 2, 275-6 (Feb., 1960). In Russian

Investigation of the thermoelectric power in the welded cont region of the pairs antimony—magnesium, tellurium—magnesium antimony—cadmium showed that rectifying (asymmetrical) curre voltage characteristics of Sb—Mg and Te—Mg pairs are due to th on of p—n junctions, and that symmetrical current—voltage eristics are obtained when such junctions are not formed). A.Tybulewicz

539.2 : 537.32

1 THERMOELECTRIC PROPERTIES OF ALLOYS OF THE PSEUDOBINARY SYSTEM Sb_2Te_3—Bi_2Te_3.

kosh and S.S.Sinani.

erdogo Tela, Vol. 2, No. 6, 1118-24 (June, 1960). In Russian.

ports a study of the electrical conductivity (σ) and thermo- c power (α) at room temperature as functions of the composi- these alloys. Positive maxima of α occurred in 70% Sb_2Te_3 + Bi_2Te_3 samples; negative maxima were found near the Te_3 + 80% Bi_2Te_3 composition. Annealing at 350°C of com- powder samples reduced the electrical conductivity of all com- ns and raised the absolute values of both the positive and e maxima of thermoelectric power. The effect of purity of ginal materials is discussed. A.Tybulewicz

539.2 : 537.32

02 MATERIALS FOR THERMOELECTRIC DEVICES MADE FROM TERNARY INTERMETALLIC COMPOUNDS.

melev.

erdogo Tela, Sbornik [Supplement] I, 63-75 (1959). In Russian.

eports a study of the electrical conductivity (σ), thermoelec- ower (α) and thermal conductivity (κ) of various compositions SbZn—SbCd and Bi_2Te_3—Sb_2Te_3 systems. In both systems the nents formed continuous series of solid solutions. At 50/50% sitions chemical compounds were formed in both systems: Cd and $SbBiTe_3$. A parameter $Z = \alpha^2\sigma/\kappa$, used to judge the ility of a material for thermoelectric applications, was $\times 10^{-3}$ deg^{-1} for Sb_2ZnSb (this was the highest value in the -SbCd system). For $SbTiTe_3$ the following values were ob- : $\sigma = 1870$ ohm^{-1} cm^{-1}, $\alpha = 145$ μV/deg (with respect to Pb) $= 0.0038$ cal cm^{-1} sec^{-1} deg^{-1}. A.Tybulewicz

ctric Properties

539.2 : 537.2

003 CONTRIBUTIONS TO THE SECOND ALL-UNION CONFERENCE ON THE PHYSICS OF DIELECTRICS.

Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 1-112; No. 2, 114-256). In Russian.

The conference was held on 20-27 November 1958, in Moscow. y four papers were presented, abstracts of which will be shed (under the appropriate headings) in this or succeeding s of "Physics Abstracts".

539.2 : 537.2

004 ELECTRIC FIELDS AND CURRENTS IN DIELECTRICS.

É.I.Adirovich.

tverdogo Tela, Vol. 2, No. 7, 1410-22 (July, 1960). In Russian.

Gives a general solution of the problem of the electric field carrier density distributions in a dielectric between two metal acts with both thermionic and field emission from the cathode. ndence of the current on the applied voltage is calculated for system metal—dielectric—metal. Limits of applicability of the oximate solutions of the same problem by Mott and Gurney ctronic Processes in Ionic Crystals. London: Oxford University s (1940)] and by the present author (1960) are considered. A.Tybulewicz

539.2 : 537.2

6005 INFLUENCE OF CRYSTALLOGRAPHIC ORIENTATION ON THE CHARGE FORMATION DURING PHASE NGES IN SOLIDS.

S.Mascarenhas and L.G.Freitas.

ppl. Phys., Vol. 31, No. 9, 1684-5 (Sept., 1960).

The effect of charge separation during phase changes (Costa iro effect) is studied with naphthalene single crystals. By erly seeding the melt it was shown that the effect is dependent rystallographic orientation. Values of the trapped charge are $\times 10^{-9}$ C/g for growth normal to cleavage plane, 2.5×10^{-9} C/g growth along b axis, and 2.9×10^{-9} C/g for growth along a axis. e effect is due to selective ionic trapping in the solid phase this ervation may be important in zone refining techniques. It if is to an electronic effect this points out to an orientation dependent ble-layer at the solid—liquid interface.

539.2 : 537.2

16006 DIELECTRIC PROPERTIES OF ISOMORPHOUS TlI—TlBr (KRS-5) CRYSTALS.

G.I.Skanavi and L.K.Vodop'yanov.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 196-8 (1959). In Russian.

Reports measurements of the permittivity and tan δ at room temperature between 500 c/s and 3 Mc/s and of the electrical conductivity at room temperature and applied fields of 0-25 V/cm. A fairly strong photodielectric effect (change of permittivity and tan δ under the action of visible light) was observed. The samples were made of KRS-5 monocrystals. A.Tybulewicz

539.2 : 537.2

16007 THE DIELECTRIC PROPERTIES OF THIN FILMS OF ZINC SULPHIDE.

R.Fuchshuber, R.Guillien and S.Roizen.

C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 51-3 (July 4, 1960). In French.

Successive evaporations in a system in which a low pressure of 10^{-7} torr could be maintained during an evaporation, enabled Al/ZnS/Al sandwiches to be made, with the Al layers about 200-600 A thick and the ZnS from 1800 to 25 000 A. For applied voltages from 0.1 to 1 V and frequencies from 1 to 50 kc/s, the dielectric constant is 10.3. C.A.Hogarth

539.2 : 537.2

16008 STATICAL CHARGES OF DEFORMED POLYMER.

C.Bazan.

Acta phys. Polon., Vol. 18, No. 2, 87-92 (1959).

Thin plates of a polyvinylchloride clamped on two sides, heated above the softening point and then cooled to room temperature, acquire electrical charges. These charges have opposite sign on opposite sides of the sample. Plates prepared in this way show optical double refraction. From the observed patterns one concludes that the chain segments are oriented preferentially in the radial direction. This effect may be related to the electrification of the sample. It is suggested that the asymmetry of the electrical charges may be due to polar group orientation.

539.2 : 537.2

16009 R.F. ELECTRICAL PROPERTIES OF SALTY ICE AND FROZEN EARTH.

J.C.Cook.

J. geophys. Res., Vol. 65, No. 6, 1767-71 (June, 1960).

The r.f. losses at 100 Mc/s in artificial samples of salty ice and frozen, fresh-water-saturated earths were measured in the laboratory, and pronounced attenuation of radio waves within distances of a few m are predicted as a general rule. Salty ice dielectric constants averaged 3.5, and resistivities "across the grain" varied from about 55 ohm-metres at −10°C to about 1200 ohm metres at −40°C for ice containing about 5‰ of salts. These results may or may not apply to natural sea ice and permafrost.

539.2 : 537.2

16010 ON THE MECHANISM OF OPTICAL IMAGING OF THE FERROELECTRIC DOMAINS IN ROCHELLE SALT CRYSTALS.

H.Flunkert.

Z. Phys., Vol. 159, No. 3, 253-71 (1960). In German.

The appearance of ferroelectric domains under the polarizing microscope is deduced from the known optical constants of the crystal. A new interference figure visible in the focal plane of the objective is predicted and its existence confirmed experimentally. The fact that the light and dark bands representing the domains change over periodically as the object plane of the microscope is lowered into the crystal is explained by considering those rays traversing the crystal at a small angle. All the phenomena are consistent with the view that the domain walls are normal to the crystal surface, i.e. parallel to the direction of spontaneous polarization. K.W.Plessner

539.2 : 537.2 : 548.7

CRYSTAL STRUCTURE OF FERROELECTRIC $LiH_3(SeO_3)_2$. See Abstr. 14032

539.2 : 537.2 : 548.7

FERROELECTRIC RARE-EARTH ALUMINATES. See Abstr. 14026

539.2 : 537.2

16011 DIELECTRIC BEHAVIOR OF SINGLE CRYSTALS OF TRI-GLYCINE SULFATE (TGS) FROM 1 kc TO 2500 Mc.

A.Lurio and E.Stern.
J. appl. Phys., Vol. 31, No. 6, 1125-6 (June, 1960).

The dielectric properties were measured in the ferroelectric direction as a function of temperature and frequency, through the Curie point, from 40 to 60°C and from 1 kc/s to 2500 Mc/s. The relaxation spectrum showing the dielectric constant and loss tangent against frequency at the Curie point is plotted. J.B.Birks

539.2 : 537.2

16012 SOME PROPERTIES OF FERROELECTRICS AT 3000 Mc/s. V.M.Petrov.

Fiz. tverdogo Tela, Vol. 2, No. 5, 997-1001 (May, 1960). In Russian.

Reports a study of the 3000 Mc/s dependence of permittivity and tan δ of monocrystalline and ceramic $BaTiO_3$ and of "Varikond" VK1 materials (barium titanate with admixtures of tin dioxide), on the magnitude of a d.c. bias field ($E_{d.c.}$). It was found that both ϵ and tan δ decrease on application of the bias field, with permittivity being reduced by a factor greater than 2 when $E_{d.c.}$ = 20 kV/cm. Hysteresis was observed in dependences of ϵ and tan δ on $E_{d.c.}$ and ageing phenomena were found. A.Tybulewicz

539.2 : 537.2

16013 THE EFFECT OF A SURFACE CHARGE LAYER ON POLARIZATION OF POLYCRYSTALLINE BARIUM TITANATE.

M.S.Lur'e and I.V.Ignat'eva.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 190-5 (1959).
In Russian.

A study of pyrocurrents (currents produced by change of polarization on rise of temperature) in ceramic and monocrystalline barium titanate showed that surface space-charge layers are responsible for the observed domain configuration. A.Tybulewicz

539.2 : 537.2

16014 AGEING OF BARIUM TITANATE MONOCRYSTALS. A.Misarova.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1276-82 (June, 1960). In Russian.

Permittivity, tan δ, hysteresis loops and d.c. conductivity of $BaTiO_3$ monocrystals were investigated as a function of time (up to 2500 hours) with and without a d.c. bias. The ageing mechanism is discussed in terms of lattice defects and impurities.
A.Tybulewicz

539.2 : 537.2

16015 TEMPERATURE DEPENDENCE OF THE VELOCITY OF SIDEWISE 180° DOMAIN-WALL MOTION IN $BaTiO_3$.

A.Savage and R.C.Miller.
J. appl. Phys., Vol. 31, No. 9, 1546-8 (Sept., 1960).

The velocity of the sidewise 180° domain-wall motion in single crystal $BaTiO_3$ has been measured over a temperature range from 25° to 100°C as a function of the applied electric field. The velocity, described by $v = v_\infty \exp(-\delta/E)$, where δ is the activation field, E the applied electric field, and v_∞ the extrapolated wall velocity for $E = \infty$, increases by about four orders of magnitude with this increase in temperature. It was found that the temperature dependence of v lies primarily in δ and not in v_∞. The magnitude of δ decreases with increasing temperature and is also dependent on the impurity concentration in the crystal as well as the crystal thickness. The effects of impurities are most pronounced at room temperature, where $(1/\delta)(d\delta/dT)$ is 1% °C^{-1} for undoped samples and 2% °C^{-1} for Fe doped samples. Though δ itself is very sensitive to the sample thickness, $(1/\delta)(d\delta/dT)$ does not appear to depend on the crystal thickness. Additional data are required before a critical comparison can be made between experiment and theory.

539.2 : 537.2

16016 PERMITTIVITY OF $BaO-MgO-TiO_2$ SAMPLES WITH COMPOSITIONS CLOSE TO $BaTiO_3$. V A.Isupov.

Zh. tekh. Fiz., Vol. 27, No. 7, 1617-19 (July, 1957). In Russian.

Reports temperature dependences (−150°C to +180°C) of ϵ and tanδ of polycrystalline samples of the systems $BaTiO_3-MgTiO_3$ and $BaTiO_3$–"BaO.MgO" at 1 kc/s in weak fields. A phase transition was observed at 98-99% $BaTiO_3$ in both systems, but the available evidence was insufficient to establish the nature of this transition (it was probably formation of a solid solution of the second type).
A.Tybulewicz

539.2 : 537.2 : 54

16017 ELECTRICAL AND X-RAY DIFFRACTION STUDIES OF THE $BaTiO_3-BaSnO_3$ SYSTEM.

Yu.N.Venevtsev, T.N.Verbitskaya, G.S.Zhdanov and S.P.Solov'ev
Fiz. tverdogo Tela, Sbornik [Supplement] I, 199-205 (1959).
In Russian.

Measurements of capacitance between −100 and +150°C and the lattice constant of the Ba(Ti, Sn)O_3 solid solutions, containing between 0 and 20 mol.% $BaSnO_3$, were used to construct a phase diagram of the system. A.Tybulew

539.2 : 537.2 : 54

16018 THE STRUCTURE AND ELECTRICAL PROPERTIES OF FERROELECTRICS OF THE $BaTiO_3-BaZrO_3$, $BaTiO_3-BaSnO_3$, $BaTiO_3-ZrO_2$ AND $BaTiO_3-SnO_2$ SYSTEMS.

T.N.Verbitskaya, E.I.Gindin and V.G.Prokhvatilov.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 180-9 (1959). In Rus

Permittivity and tan δ of solid solutions of these systems we measured at 1 kc/s and their temperature dependences obtained between −150° and +150°C. The phase transitions were deduced from the temperatures of the permittivity maxima. These resul together with X-ray diffraction studies of the structure between 20° and 200°C, were used to construct a phase diagram of the $BaTiO_3-ZrO_2$ system between 0 and 15 mol.% ZrO_2. $BaTiO_3$–Zr and $BaTiO_3-SnO_2$ were found to be promising ferroelectric cera materials. A.Tybulew

539.2 : 5

16019 FERROELECTRIC PROPERTIES OF SOLID SOLUTI OF THE Ba(Ti,Zr,Sn)O_3 TERNARY SYSTEM.

M.M.Mekrasov and Yu.M.Poplavko.
Fiz. tverdogo Tela, Vol. 2, No. 8, 1681-4 (Aug., 1960). In Russia

Describes methods of preparation of ferroelectric ceramics with high nonlinearity and comparatively small losses. Reports results of an investigation of the Ba(Ti,Zr,Sn)O_3 solid solutions. For the optimum composition of this system (with Ti, Zr and Sn the proportion of 85 : 11 : 4) the maximum reversible nonlinearit defined as $N_r = \epsilon^{-1}(d\epsilon/dE)$, where ϵ is the permittivity and E i the electric field in kV/cm, was found to be −0.9 cm/kV. The di electric losses of this composition were represented by tan δ = 0 in weak fields and 0.15 in strong fields. A.Tybulew

539.2 : 5

16020 DIELECTRIC POLARIZATION OF SOLID SOLUTION OF DI- AND TRIVALENT METAL METANIOBATES

G.A.Smolenskii, Ya.I.Ksendzov, A.I.Agranovskaya and S.N.Popov
Fiz. tverdogo Tela, Sbornik [Supplement] II, 244-50 (1959).
In Russian.

$BaNb_2O_6$, $SrNb_2O_6$ and $CaNb_2O_6$ (which are non-ferroelectric were found to form ferroelectric substitutional solid solutions wit the lead metaniobate ($PbNb_2O_6$) structure. Substitutional–defect solid solutions were formed in the systems $BaNb_2O_6$–"$La_{2/3}Nb_2O$ and $BaNb_2O_6$–"$Bi_{2/3}Nb_2O_6$"; the high permittivity of the latter sol tions was partly due to relaxation polarization. A.Tybulewi

539.2 : 5

16021 DIELECTRIC PROPERTIES OF LEAD TITANATE ZIRCONATE CERAMICS AT VERY LOW FREQUENC

R.Gerson.
J. appl. Phys., Vol. 31, No. 9, 1615-17 (Sept., 1960).

Dielectric properties of lead titanate zirconate were determined between room temperature and 140°C at frequencies betw 0.1 and 10 c/s. A measured increase in dielectric constant and dissipation factor at low frequency and high temperature was interpreted as an anomalous conduction phenomenon, rather than an effect due to ferroelectric polarization. Over the frequency a temperature range studied the relationship between the real and the imaginary components of the dielectric constant was found to linear. The data for unpoled ceramic and for material which had been poled to a maximum in piezoelectric activity were quite sim lar.

539.2 : 5

16022 THE POLARIZATION OF IONIC CRYSTALS CONTA ING RELAXING DEFECTS. I.Ts.Lyast.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1256-63 (June, 1960). In Russi

The theory of Kirkwood and Fröhlich is applied to an ionic lattice, containing relaxing defects, each treated as a rigid freely rotating dipole. The results are applicable also to more general defects (Abstr. 2179 of 1957). The interaction between dipole and e explains the sharp increase of dielectric constant which npanies the addition of impurities to the rutile and perovskite tures (Abstr. 1672 of 1958). I.D.C.Gurney

539.2 : 537.2

023 INTERACTION OF IONS IN A PEROVSKITE LATTICE.
I.Ts.Lyast.

tverdogo Tela, Vol. 2, No. 6, 1269-75 (June, 1960). In Russian.

Formulae obtained earlier (see preceding abstract) are used lculate the relaxation polarization in a perovskite crystal. It sumed that the relaxation units are Ti ions in the neighbour- of impurity atoms. The results explain the observed high es of permittivity (~ 1000). The potential energy of a Ti ion in arium titanate lattice and the mutual interaction of Ti ions are ulated. A.Tybulewicz

539.2 : 537.2

024 THE INTERNAL FIELDS OF SOME FERROELECTRICS WITH THE PEROVSKITE-TYPE STRUCTURE.

.Venevtsev, G.S.Zhdanov, S.P.Solov'ev and Yu.A.Zubov.

tallografiya, Vol. 3, No. 4, 473-9 (1958). In Russian. English slation in: Soviet Physics—Crystallography (New York), Vol. 3, 4, 471-7 (July-Aug., 1958).

An analysis is made of the methods of calculating these fields. internal fields and spontaneous polarization are calculated for tals of the tetragonal modifications of $BaTiO_3$ and $PbTiO_3$. The ence of certain parameters of the cations on the internal fields the spontaneous polarization of ferroelectrics of this type is ied.

539.2 : 537.2

6025 THE TEMPERATURE DEPENDENCES OF ϵ' AND ϵ" OF STRONTIUM—BISMUTH TITANATE AND OF IUM TITANATE AT 9400 Mc/s. G.A Lipaeva and G.I.Skanavi.

tverdogo Tela, Vol. 2, No. 3, 506-8 (March, 1960). In Russian.

Measurements of complex permittivity of 80.3% $SrTiO_3$ + 19.7% $)_3.2TiO_2$ and of $BaTiO_3$ between −180° and +250° C confirmed the xation nature of polarization in $SrTiO_3 + Bi_2O_3.2TiO_2$. A.Tybulewicz

539.2 : 537.2

16026 DETERMINING THE DISINTEGRATION ENERGY OF SOLID DIELECTRICS ON BREAKDOWN.

.Vorob'ev and G.A.Andreev.

. tverdogo Tela, Vol. 2, No. 5, No. 5, 987-92 (May, 1960). Russian.

A method is described for measuring the energy dissipated in various stages of breakdown, by taking simultaneous oscillographs current and voltage in a dielectric. The breakdown energy de- nds on the temperature, thickness and chemical composition of sample; it increases with the thickness; and the lattice energy. e lattice energy of a solid crystalline dielectric, and the binding rgy of an amorphous dielectric, can be evaluated from the akdown energy and the volume of material disintegrated in the akdown channel. Graphs shown relate to NaCl, KCl and KBr. ircuit diagram is given for measuring total energy loss on break- vn by a calorimetric method. D.E.Brown

539.2 : 537.2

16027 PIEZOELECTRICITY AND CONDUCTIVITY IN ZnO AND CdS. A.R.Hutson.

ys. Rev. Letters, Vol. 4, No. 10, 505-7 (May 15, 1960).

The piezoelectric constants and elastic moduli of ZnO and CdS ystals have been determined. In order to quench the conductivity, n-type crystals were compensated with Li acceptors, which ised the resistivity to the order of 10^{12} ohm cm. The piezoelectric attering appears ample to account for the large phonon drag with a all effective mass, observed in thermoelectric power measure- ents on ZnO. J.B.Birks

539.2 : 537.2

16028 THE ELECTROMECHANICAL PROPERTIES OF BARIUM TITANATE. H.L.Allsopp and D.F.Gibbs.

il. Mag. (Eighth Ser.), Vol. 4, 359-70 (March, 1959).

Measurements in the form of oscillograms have been made of e electric field E, the electric displacement D, and the strain x, both single crystal and ceramic barium titanate over a wide mperature range. Below the Curie point results depend strongly the type of sample, and are given an interpretation in terms of main change and piezoelectric mechanisms. Above the Curie mperature all specimens show electrostrictive behaviour with a efficient Q_{33} which within experimental error is independent of ecimen type, temperature, and applied field.

539.2 : 537.2

16029 MEASUREMENT OF COUPLING COEFFICIENT AND Q OF LOW-Q PIEZOELECTRIC CERAMICS.

R.M.Glaister.

Brit. J. appl. Phys., Vol. 11, No. 8, 390-1 (Aug., 1960).

The usual method of measuring k and Q cannot be used for low-Q piezoelectric elements having a figure of merit of less than 2. To cater for these materials, a resonance method avoiding any approximations was devised and it is illustrated by reference to measurements made with a Pb niobate disk vibrating in the thickness mode. The motional Q is 56, k_{33} is 0.13 and the figure of merit 0.95. Another method, due to Farren, giving similar results is described for use when the resonance—capacitance curve is ill-defined. H.J.H.Starks

539.2 : 537.2 : 548.5

GROWING OF TERPINE MONOHYDRATE CRYSTALS AND THEIR ELASTIC AND PIEZOELECTRIC PROPERTIES. See Abstr. 13952

539.2 : 537.2 : 534.13

16030 THE OSCILLATIONS OF DIELECTRIC BODIES.
I.S.Zheludev.

Kristallografiya, Vol. 4, No. 4, 571-4 (July-Aug., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 535-7 (April, 1960).

Suspended bodies containing certain dielectric substances will freely, and without external aid, perform oscillations; if an electric field is applied, they perform forced oscillations. The system used in one such experiment uses a dielectric disk fitted with electrodes and fixed to a springy rod; the oscillations cause a light beam to be deflected by an attached mirror, the moving image falling on to a scale for measurement. These free oscillations were observed at room temperature when Y-cut sections of $Li_2SO_4 \cdot H_2O$ or X-cut sections of Rochelle salt ($NaKC_4H_4O_6 \cdot 4H_2O$) were used. These oscillations occur at the natural frequency of the mechanical system (10 cycles per second, or so). A curious effect is that these oscillations occur even if the electrodes are short-circuited. The amplitude of the oscillations varies; it is as though a beat frequency of a tenth or hundredth part of a cycle per second were present. The maximum amplitude is fairly constant at any given temperature. Rochelle salt was used see how the maximum amplitude varies with temperature over the range from +10 to +35° C. The cause of these oscillations has not been established nor can the amplitude be related to any physical parameters of the crystal.

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535

16031 A PHOTOGRAPHIC METHOD OF MEASURING OPTICAL CONSTANTS OF METALS.

I.N.Shklyarevskii and A.I.Sharapov.

Optika i Spektrosk., Vol. 8, No. 2, 239-42 (Feb., 1960). In Russian.

Describes a photographic method of measuring optical constants of metals in the visible and ultraviolet regions. This method is a modification of the Shklyarevskii et al. polarization method of measuring optical constants of metals in the visible and infrared regions, based on the use of multiple reflection of light from two parallel identical samples (Abstr. 10864-5, 12130 of 1959). A.Tybulewicz

539.2 : 535

16032 THE TEMPERATURE DEPENDENCE OF THE REFRACTIVE INDEX OF SILICON. F.Lukeš.

J. Phys. Chem. Solids, Vol. 11, No. 3-4, 342-44 (Oct., 1959).

The results are given for the temperature range 109-750° K and the wavelength range 1.1-1.8 μ; they are consistent with theory. C.D.Cox

539.2 : 535

16033 OPTICAL PROPERTIES OF SYNTHETIC SPINEL.
K.A.Wickersheim and R.A.Lefever.

J. Opt. Soc. Amer., Vol. 50, No. 8, 831-2 (Aug., 1960).

Spinel single crystals of stoichiometric composition $MgO.Al_2O_3$ were grown by the flame-fusion process. The transmission in the infrared was greater than for commercial Al-rich spinel. The refractive indices for commercial and stoichiometric spinels were 1.720 and 1.708 respectively. The refractive index increased again on the Mg-rich side. J.Franks

539.2 : 535

16034 DIRECT DETERMINATION OF THE OPTICAL CONSTANTS OF SODIUM AND POTASSIUM IN THE ULTRAVIOLET.

S.Robin and St.Robin.

J. Phys. Radium, Vol. 20, No. 11, 918-19 (Nov., 1959). In French.

Refractive indices (n) were determined by observing interference fringes on reflection at thin films, the thickness being determined by chemical estimation; absorption coefficients are calculated from transmission measurements. Values of n (2.75 for Na at 1800 A, 3.5 for K at 2800 A) are considerably different from those found for thick layers. G.F.Lothian

539.2 : 535

16035 GENERALIZED FRESNEL FORMULAE FOR THE SURFACE OF A CRYSTAL TAKING ACCOUNT OF THE ANISOTROPIC EFFECTIVE MASS OF THE EXCITON.

B.E.Tsekvava.

Fiz. tverdogo Tela, Vol. 2, No. 3, 482-8 (March, 1960). In Russian

Obtains generalized formulae for the passage of light across the boundary crystal—vacuum. Expressions are obtained for the coefficient of reflection of light at the crystal surface and also for the transmission, reflection and absorption of light across a plane parallel slab of crystal. Experiments are considered by which a check could be obtained from the optical anisotropy of cubic crystals (class O_h, e.g. NaCl, CsCl; C, Ge, Si; Cu_2O etc.,). W.Bardsley

539.2 : 535 : 537.3

16036 OPTICAL AND ELECTRICAL PROPERTIES OF THIN LAYERS OF TIN DIOXIDE.

V.K.Miloslavskii and S.P.Lyashenko.

Optika i Spektrosk., Vol. 8, No. 6, 868-74 (June, 1960). In Russian.

Reports an investigation of the temperature dependences of the Hall constant and the electrical conductivity of thin Sb-doped layers of SnO_2 in a wide range of temperatures (200-300° C), of the wavelength dependence of the transmission coefficients between 0.35 and 2.5 μ and of the optical reflectivity between 1.5 and 6 μ. The experimental values of the reflectivity and the transmission coefficient, together with the known thicknesses of the samples, were used to calculate the optical constants n and k in the absorption-edge region (1.7-2.5 μ). The optical constants were used to find the real part of permittivity. A.Tybulewicz

539.2 : 535

16037 OPTICAL OBSERVATIONS CONCERNING THE POLYMORPHIC TRANSITION IN THE POTASSIUM HALIDES.

S.Wiederhorn and H.G.Drickamer.

J. appl. Phys., Vol. 31, No. 9, 1665-71 (Sept., 1960).

At approximately 20 000 atm the potassium halides undergo a phase transition from the f.c.c. (NaCl) structure to the s.c. (CsCl) structure. Various optical effects were observed including the rate of cutoff of the light and the wavelength dependence of the scattered light. The phase transition is apparently initiated by shear involving a large cutoff of light with little or no volume change. At the beginning and end of the transition the scattering is largely small particle scattering, with large particles dominating the middle region. Rb^+ impurity has little effect on the transition. Na^+ impurity apparently inhibits the nucleation strongly, and, to some extent, the growth. From the absorption spectra of Pb^{++} ion impurity it is apparent the nuclei consist of hundreds of ions, rather than smaller units.

539.2 : 535

16038 MAGNETO-OPTICAL ROTATION IN VERY HIGH FIELDS.

R.Stevenson.

Canad. J. Phys., Vol. 38, No. 7, 941-4 (July, 1960).

Magneto-optical rotation by transmission through or reflection from solids is examined by the classical free electron theory, with the view of taking such a measurement using fields in the megagauss range. In general the rotation is a markedly non-linear function of the magnetic field, and in some cases can change in sign as the field increases. For very low fields the rotation varies directly with B, but in the high field limit the rotation varies inversely with the field. For substances in which the intercollison time of the electron is small, measurements of the Kerr rotation (i.e. by reflection) will give the electron mobility as a function of the magnetic field, and thus will give important data which can be used in conjunction with high field magnetoresistance experiments.

539.2

16039 SPECTRAL DISTRIBUTION OF PHOTOSENSITIVITY IN P-TYPE INDIUM ANTIMONIDE.

D.N.Nasledov, M.P.Pronina and Yu.A.Smetannikova.

Fiz. tverdogo Tela, Vol. 2, No. 2, 239-41 (Feb., 1960). In Russi

Reports measurements of the spectral characteristics (λ = 2-7 μ) of photoconductivity and photomagnetic effect of mon crystals with acceptor concentrations from 10^{13} to 10^{15} cm^{-3}. The crystals were prepared by zone melting and measurements were carried out at liquid nitrogen and at higher temperatures. forbidden bandwidth at 77° K deduced from the red edge of the ph conductivity spectrum (at 6.5-7 μ), was the same for all samp $\Delta E = 0.22$ eV; its temperature coefficient was $\Delta E/\Delta T =$ $= -2.4 \times 10^{-4}$ eV/deg. A.Tybulew

539.2 :

16040 STRUCTURAL INTERPRETATION OF ANOMALOUS SCATTERING OF VISIBLE LIGHT IN SODIUM-BOROSILICATE GLASSES.

N.S.Andreev, V.I.Aver'yanov and N.A.Voishvillo.

Fiz. tverdogo Tela, Vol. 2, No. 5, 1011-21 (May, 1960). In Russi

The curves of scattering intensity of visible light at large angles and those of scattering intensity of X-rays at small angle were found to have qualitatively identical shapes for the same values of the parameter $(\sin \theta)/\lambda$. F.Lach

539.2 :

16041 A THEORY OF ABSORPTION OF LIGHT IN CRYSTA

V.M.Agranovich and A.A.Rukhadze.

Fiz. tverdogo Tela, Sbornik [Supplement] II, 235-41 (1959). In Russian.

A phenomenological theory of propagation of electromagneti waves (Abstr. 1625 of 1959) is used to calculate the coefficient of attenuation due to the interaction of polarization waves with acou and optical (non-active) lattice vibrations. The forms of the disperison and absorption curves are discussed for an isotropic me A.Tybulev

539.2

16042 A THEORY OF TEMPERATURE DEPENDENCES OF THE OPTICAL DISPERSION AND OF THE EXCITON ABSORPTION OF LIGHT IN CRYSTALS.

S.I.Pekar and V.L.Strizhevskii.

Fiz. tverdogo Tela, Vol. 2, No. 5, 894-7 (May, 1960). In Russian

Pekar's theory of the optical dispersion and exciton absorpt of light in crystals is extended here to temperatures higher than the absolute zero. An additional term in the polarizability of a crystal is obtained, as well as its temperature dependence. A.Tybulew

539.2 :

16043 THE TEMPERATURE DEPENDENCE OF DISPERSIC AND ABSORPTION OF LIGHT IN MOLECULAR CRYSTALS. I. THEORY.

V.L.Strizhevskii.

Optika i Spektrosk., Vol. 8, No. 5, 623-8 (May, 1960). In Russian

Applies Pekar's theory (1957, 1959) of dispersion and absor of light in the exciton-absorption region to a molecular crystal w weak exciton—phonon coupling. Expressions are derived which g the temperature dependences of the refractive index and the abso tion coefficient. Qualitative conclusions which follow from these expressions are discussed. A.Tybulew

539.2 :

16044 OPTICAL DISPERSION OF GERMANIUM.

M.I.Kornfel'd.

Fiz. tverdogo Tela, Vol. 2, No. 1, 48-9 (Jan., 1960). In Russian.

Reports a study of the optical dispersion in germanium mon crystals (~ 50 ohm cm) in the region λ = 1.5-2.2 μ from 80 to 46 The results can be represented by

$$n^2 = A + B/(E_*^2 - E^2),$$

where n is the refractive index, $E = h\nu$ is the energy of light qua $A = 12.7$, $B = 6.0$ and E_* is a parameter which falls from 1.43 eV 80° K to 1.25 eV at 460° K. A.Tybulew

539.2 :

16045 ABSORPTION OF LIGHT IN GERMANIUM.

M.I.Kornfel'd.

Fiz. tverdogo Tela, Vol. 2, No. 1, 179-80 (Jan., 1960). In Russi

The absorption coefficient of monocrystalline germanium ohm cm), between 290 and 550°K, was found to obey the ionship $\alpha = A \exp[-(E_0 - E)/kT]$, where $A = 2 \times 10^4$ cm^{-1}, 0.89 eV, $E = h\nu$ and T is the absolute temperature.

A.Tybulewicz

539.2 : 535

16046 THE THEORY OF INFRARED ABSORPTION OF CRYSTALS. L.É.Gurevich and Z.I.Uritskii.

tverdogo Tela, Vol. 2, No. 6, 1239-49 (June, 1960). In Russian.

The causes of absorption examined are: (1) Formation of vir- electron—hole pairs, which are annihilated with formation of or more phonons. For atomic crystals the maximum absorp- is by two-phonon emission. (2) Absorption by free carriers ide the range of diamagnetic resonance ($\omega \geq \Omega$), where Ω is the nor frequency. Oscillations of the absorption coefficient can r with periods depending on the degeneracy and the ratio of o T (in energy units). The coefficient is anisotropic with respect e relative orientation of the field and the photon polarization. bsorption by the internal photoeffect in a magnetic field, when rete lines are superimposed on the oscillations of continuous rption. Anisotropy should again occur.

R.Berman

539.2 : 535.33

16047 INVESTIGATION OF THE REFLECTION AND LUMINESCENCE SPECTRA OF COPPER HALIDES LOW TEMPERATURES.

.Gross, B.S.Razbirin and R.I.Shekhmamet'ev.

ika i Spektrosk., Vol. 8, No. 2, 232-8 (Feb., 1960). In Russian.

Reports an investigation of the diffuse reflection and lumines- ce spectra of CuI, CuBr and CuCl sublimated layers and fine- ined powders at 77°K in the spectral region around the funda- ntal absorption edges of these three compounds. It was found the spectra of the three halides had many common features. orbed gases affected strongly the luminescence and reflection ctra of CuI and CuBr. The luminescence spectra of CuI and Br included groups of equidistant lines similar to those observed dS, CdSe, ZnS, ZnO etc. The short-wavelength weak lumines- ce lines of CuI, CuBr and CuCl, which coincided with the orption lines and were not greatly affected by surface treatments, e due to processes occurring in the interior of the lattice. The g-wavelength strong luminescence lines were due to surface cesses.

A.Tybulewicz

539.2 : 535.33

16048 EXPERIMENTAL INVESTIGATIONS OF EXCITON SPECTRA IN IONIC CRYSTALS. S.Nikitine.

il. Mag. (Eighth Ser.), Vol. 4, 1-31 (Jan., 1959).

An account is given of the experimental results obtained since 53 in the author's laboratory for crystal spectroscopy. With a mber of crystals, including Cu_2O, CuCl, CuBr, CuI, AgI, HgI_2, I_2, TlCl, TlBr, and TlI, line spectra could be observed at low mperatures in absorption and in emission. The reflection spectra ve also been studied. The occurrence of a line spectrum appears be a characteristic feature of pure ionic crystals and the general operties of these spectra are outlined. Three classes of line ectra have been observed. The spectra of two of the classes are reasonable agreement with the predictions of recent theories of citon spectra while those of the third class are most probably also citon spectra of a type which has not yet been treated theoretically. her interpertations are, however, possible. When very thin mples (0.1 μ) are used for the observation of spectra of the first ass, there is only a weak continuum and the spectra consist mainly a few strong characteristic lines ("raies ultimes"); these might ssibly be used for analytical purposes. The intensities of lines the spectra of the third class are extremely sensitive to the quality the crystal. The results of experiments are in qualitative agree- ent with recent theories of exciton spectra; but an entirely satis- ctory interpretation of the spectra cannot yet be given.

539.2 : 535.33

16049 THE POSITIONS OF THE ABSORPTION BANDS OF ELECTRON DEFECTS IN IONIC LATTICES. O.Stasiw.

ta phys. Hungar., Vol. 9, No. 1-2, 229-35 (1958). In German.

Discusses the empirical relation given by Koswig (see Abstr. 74 of 1958) for the positions of absorption bands due to impurity ions (O^{2-}, S^{2-}, Se^{2-}, Te^{2-}) in silver halide lattices. It is possible relate these positions qualitatively with the colour centre bands, terms of the polarizability of the impurity ion.

G.F.Lothian

539.2 : 535.33

16050 CENTER LAW OF THE LATTICE VIBRATION SPECTRA. J.N.Plendl.

Phys. Rev., Vol. 119, No. 5, 1598-603 (Sept. 1, 1960).

The lattice vibration spectra of a solid, as a whole, can be characterized by one single frequency, defined as the frequency of "the centre of gravity" of the infrared spectrum, simply called "centre frequency." Data of this frequency have been determined for many nonconducting solid compounds from the experimental spectra of lattice vibrations in reflectance as well as in absorption. A striking experimental phenomenon is discovered: the centre frequency, whether determined from the reflectance or from the absorption type spectrum, is found to be equivalent and identical with Debye's charateristic frequency. This phenomenon is exhibited for a large variety of nonconducting compounds covering almost the entire range of the vibrational spectra of solids. Moreover, the centre frequency remains constant with varying temperature. The equality of the centre frequency of the infrared spectrum and the characteristic frequency from specific heat constitutes the "centre law of the lattice vibration spectra."

539.2 : 535.33

16051 ON THE LOW TEMPERATURE OPTICAL ABSORPTION OF $CoCl_2.6H_2O$ AND $CoBr_2.6H_2O$. R.Pappalardo.

Phil. Mag. (Eighth Ser.), Vol. 4, 219-42 (Feb., 1959).

The optical absorption of crystals of $CoCl_2.6H_2O$ and $CoBr_2.6H_2O$ was studied at room temperature, 90°K and 20°K. Some peculiarities in these spectra are reported and discussed. A tentative assignment of the observed transitions to levels predicted in terms of crystal field theory is made, obtaining a satisfactory agreement, if an appropriate set of parameters is used.

539.2 : 535.33

16052 INTENSITY AND FINE STRUCTURE OF THE MAIN OPTICAL ABSORPTION BANDS IN HYDRATED COBALTOUS SALTS. S.Koide.

Phil. Mag. (Eighth Ser.), Vol. 4, 243-52 (Feb., 1959).

The fine structure and the intensities of the main optical absorption bands in hydrated cobaltous salts are investigated theoretically on the basis of the crystal field theory. Calculations are made on the assumption that the crystal field is of cubic symmetry, and the same model as used in the previous calculation for Mn^{2+} salts is adopted for the normal vibrations of the complex. Reasonable agreements between observed and calculated results are obtained.

539.2 : 535.33

16053 THE ABSORPTION SPECTRA OF DIAMONDS. G.O.Gomon.

Optika i Spektrosk., Vol. 8, No. 3, 406-8 (March, 1960). In Russian.

Reports the absorption spectra of diamonds (from various deposits in the Soviet Union) recorded between 3000 and 7000 A at temperatures from 80°K upwards.

A.Tybulewicz

539.2 : 535.33

16054 ABSORPTION SPECTRUM AND ZEEMAN EFFECT OF CRYSTALLINE DYSPROSIUM SALTS AT LOW TEMPERATURES. G.Gramberg.

Z. Phys., Vol. 159, No. 2, 125-48 (1960). In German.

Spectrograms are given for the blue-violet region for single crystals of the ethylsulphate, chloride and nitrate at 58° and 4.2°K. The bands are analysed in accordance with methods previously set out (see Abstr. 7816 of 1958) for Sm. Calculated values of magnetic suceptibility and magnetic specific heat accord with direct measurements.

G.F.Lothian

539.2 : 535.33

16055 OPTICAL ABSORPTION IN N-TYPE GALLIUM PHOSPHIDE.

W.G.Spitzer, M.Gershenzon, C.J.Frosch and D.F.Gibbs.

J. Phys. Chem. Solids, Vol. 11, No. 3-4, 339-41 (Oct., 1959).

The 1-4μ absorption band in n-type gallium phosphide could arise from transitions between two sets of conduction band minima with ~ 0.3 eV separation.

C.D.Cox

539.2 : 535.33

16056 FUNDAMENTAL OPTICAL ABSORPTION IN AMORPHOUS AND CRYSTALLINE GERMANIUM.

P.G.Borzyak and R.D.Fedorovich.

Fiz. tverdogo Tela, Vol. 2, No. 1, 45-7 (Jan., 1960). In Russian.

Measurements of the reflection and transmission spectra of thin (0.02-0.14 μ) films on quartz bases were used to obtain the absorption spectra of amorphous and crystalline germanium in the region λ = 200-1100 mμ. In crystalline germanium a sharp maximum was observed at λ ≅ 280 mμ and a diffuse maximum at λ ≅ 500 mμ; amorphous germanium had a very broad maximum at λ ≅ 370 mμ and an inflection at λ = 800-900 mμ. The differences between the spectra of amorphous and crystalline material were ascribed to differences in the long-range order. A.Tybulewicz

539.2 : 535.33

16057 SOME OPTICAL PROPERTIES OF INDIUM ARSENOSELENIDE AND ARSENOTELLURIDE SOLID SOLUTIONS.

D.N.Nasledov, M.P.Pronina and S.I.Radautsan.
Fiz. tverdogo Tela, Vol. 2, No. 1, 50-1 (Jan., 1960). In Russian.

The optical absorption edges in the 1-5 μ region yielded the following values for the forbidden band widths (in eV): 0.3 for InAs; 0.4 for $4InAs.In_2Se_3$; 0.5 for $2InAs.3In_2Se_3$; 0.6 for $InAs.In_2Te_3$; 0.7 for $InAs.3In_2Te_3$ and 1.2 for In_2Se_3. A.Tybulewicz

539.2 : 535.33

16058 ABSORPTION SPECTRA OF $MnCl_2$ AND $MnBr_2$.

J.W.Stout.
J. chem. Phys., Vol. 33, No. 1, 303 (July, 1960).

Absorption bands in single crystals observed by Pappalardo (see Abstr. 1728 of 1960) are interpreted by calculating the perturbations of the levels of the free Mn^{++} ion using adjustable values of covalency (ε) and ligand field parameters, as previously done for MnF_2 (see Abstr. 12041 of 1959). Good agreement is found using values of ε that are reasonable. G.F.Lothian

539.2 : 535.33

16059 NOTE ON THE OPTICAL ABSORPTION OF $MnCl_2$ AND $MnBr_2$.

R.Pappalardo.
J. chem. Phys., Vol. 33, No. 2, 613-14 (Aug., 1960).

New absorption bands are reported in the ultraviolet down to 2400 A for single crystals at room temp. and 78°K. Theoretical considerations using the method of the author (see Abstr. 1728 of 1960) and of Stout (see preceding abstract) both give the correct number of bands and approximately correct values for the excited levels. G.F.Lothian

539.2 : 535.33

16060 OPTICAL ABSORPTION IN IRRADIATED QUARTZ AND FUSED SILICA.

C.M.Nelson and J.H.Crawford, Jr.
J. Phys. Chem. Solids, Vol. 13, No. 3-4, 296-305 (June, 1960).

Optical absorption studies over the range from 1850 to 26000 A have been performed on crystalline quartz and fused silica after exposure to both fast neutrons in the reactor and Co^{60} γ-rays. The prominent band near 2150 A is produced by γ-rays and neutrons in fused silica but fast neutron exposures in excess of 5×10^{18} cm^{-2} are necessary to cause appreciable development of the corresponding band in crystalline quartz. With shorter neutron exposures and γ-rays the absorption in quartz crystals is characterized by the broad visible bands and continuous absorption which rises almost linearly toward shorter wavelength below 3000 A. This continuous absorption probably corresponds to the long wavelength tail of one of the bands observed by Mitchell and Paige in the vacuum ultraviolet region. These results do not seem to agree with their interpretation of the nature of the 2200 A band in quartz. On annealing neutron-irradiated quartz (5×10^{18} neutrons/cm^2) at 250°C a new band at 2000 A develops. In fused silica, besides the 2150 A band, the shoulder at 2400 A (resolved by appropriate optical bleaching as a band at 2570 A) which has previously been reported, was observed with both γ-rays and fast neutrons. The rates of coloration of quartz and fused silica as well as studies of optical and thermal bleaching are discussed. In the fused materials a mechanism of photolytic coloration which appears to be consistent with observations provides a suitable model which is based on the rupture of Si—O bonds with the formation of free radicals as the principal product. These and other possible defects are discussed in the light of magnetic susceptibility and electron spin resonance studies.

539.2 : 535.33

16061 THE TEMPERATURE DEPENDENCE OF THE WIDE ABSORPTION BANDS IN THE SPECTRA OF CRYSTALS WITH VARIOUS STRUCTURES, COLOURED BY ISOMORPHOUS IMPURITIES.

S.V.Grum-Grzhimailo and G.V.Klimusheva.
Optika i Spektrosk., Vol. 8, No. 3, 342-51 (March, 1960). In Russian.

The absorption spectra of ruby, alexandrite, emerald and tourmaline (containing Cr^{3+}, V^{3+}, Mn^{3+} + Fe^{2+}, Cr^{3+} + Fe_2^{2+}) were recorded at temperatures from 103° to 823°K. The non-overlapp maxima showed satisfactory agreement with the theory of Pekar a Davȳdov (1952-3). A.Tybulew

539.2 : 535.33 : 537.3

16062 ABSORPTION EDGE IN β-SILICON CARBIDE.

R.Dalven.
J. Phys. Chem. Solids, Vol. 13, No. 1-2, 163-4 (May, 1960).

Optical absorption of β-SiC at room temperature is reported for photon energies of 2.3 to 2.9 eV. The results indicate an optic energy gap of 2.2 ± 0.1 eV. C.D.C

539.2 : 535.

16063 IDENTIFICATION OF COLLOIDAL SODIUM IN SODIUM AZIDE.

B.S.Miller.
J. chem. Phys., Vol. 33, No. 3, 889-91 (Sept., 1960).

Under treatment with ultraviolet radiation and heat, sodium azide develops an optical absorption band centred at 520 mμ. The centres responsible for this band were identified by the dual techniques of electron spin resonance and cryoabsorption spectroscop as colloidal sodium.

539.2 : 535.

16064 α AND β BANDS IN NaF, NaCl, AND KCl.

R.Onaka and I.Fujita.
Phys. Rev., Vol. 119, No. 5, 1597-8 (Sept. 1, 1960).

By means of a vacuum spectrophotometer, α and β bands wer observed in NaF, NaCl, and KCl irradiated by soft X-rays. At liquid nitrogen temperature, the positions of α band are 9.4_3 eV in NaF, 7.1_6 eV in NaCl and 6.9_8 eV in KCl, and the positions of β ba 9.7_5 eV in NaF, 7.3_8 eV in NaCl, and 7.3_1 eV in KCl. The doublet structure of β band in NaCl, expected by Fuchs' theory, was not detected. This may be due to the fairly wide bandwidth of the component bands.

539.2 : 535.

16065 OPTICAL ABSORPTION OF F BANDS IN THALLIUM-DOPED POTASSIUM HALIDES.

J.J.Markham and H.N.Hersh.
J. chem. Phys., Vol. 32, No. 6, 1855 (June, 1960).

Measurements of the half-widths of the F-band in potassium halides with and without thallium impurity showed that the presenc of thallium did not affect the half-width. However, such doping di affect the thermal and optical behaviour of F-centre effects an the type of V-centres produced. G.F.J.Garli

539.2 : 535.

16066 THE RELATIONSHIP BETWEEN THE ELECTRONIC SPECTRA OF IMPURITY MOLECULES AND THE LATTICE VIBRATIONS OF A CRYSTALLINE SOLVENT.

V.N.Vatulev.
Optika i Spektrosk., Vol. 8, No. 5, 727-9 (May, 1960). In Russian.

Absorption satellites of a purely electronic line (25898 cm^{-1}) observed at 20°K in the spectrum of 9,10-dihydroanthracene crystals, containing anthracene as an impurity, were mirror-symmetrical images of the luminescence satellites. This mirror symmetry confirms that the absorption and luminescence lines are both due to the same type of centre and that they are produce by interactions of internal transitions with vibrations of the solve lattice. A.Tybulewi

539.2 : 535.

16067 POLARIZED VISIBLE SPECTRA OF CRYSTALLINE TRISOXALATOMETALLATES: THE SOURCE OF INTENSITY.

T.S.Piper and R.L.Carlin.
J. chem. Phys., Vol. 33, No. 2, 608-9 (Aug., 1960).

Variations of absorption spectra for V, Cr and Co salts, dilut in the transparent NaAlMg salt, observed in various directions show that the transitions are electric dipole excited. At 77°K spin forbidden transitions were observed and the polarization variatio again indicate electric dipole transitions; the transitions are made possible by spin-orbit coupling of the $^1A_1$ state to triplet states. G.F.Loth

539.2 : 535.

16068 THE INFRARED ABSORPTION OF HOT SEMI-CONDUCTING DIAMONDS.

C.D.Clark, P.Kemmey, E.W.J.Mitchell and B.W.Henvis.
Phil. Mag. (Eighth Ser.), Vol. 5, 127-39 (Feb., 1960).

Measurements of the absorption of p-type semiconducting diamonds have been made at temperatures in the range 450 to 600 over the wavelength range between 6 and 45 μ. The major ct observed is an absorption, which is present only in hot semi- ducting diamonds, which increases with increasing wavelength temperature. The increase with temperature is similar to that ne increase in carrier concentration as determined from meas- ments of the Hall effect. The observed wavelength dependence ers from that predicted by the theory of intervalence band ab- ption for mass ratios of 1.04, 1.25, 2.5 and 5. It is possible to ount for the shape of the spectrum using the single band free rier theory of Donovan and March. However, the relaxation es deduced are small (~ 10^{-14} sec at 563° K) and there is a dis- pancy between the calculated and observed magnitude of absorp- .

539.2 : 535.33

16069 **INFRARED ABSORPTION SPECTRA OF ALKALI METAL NITRATES AND NITRITES ABOVE AND LOW THE MELTING POINT.** J.Greenberg and L.J.Hallgren.
hem. Phys., Vol. 33, No. 3, 900-2 (Sept., 1960).

The infrared absorption spectra of $LiNO_3$, $NaNO_3$, KNO_3, $RbNO_3$, NO_3, $NaNO_2$, and KNO_2 above and below the melting point were obtained supporting the salts in the interstices of a fine mesh platinum een (see Abstr. 6926 of 1960). The frequencies observed were igned values according to the symmetry classification. The ects of temperature and cation size were also noted.

539.2 : 535.33

16070 **INFRARED ABSORPTION OF DEFECTS IN QUARTZ.** D.L.Wood.
Phys. Chem. Solids, Vol. 13, No. 3-4, 326-36 (June, 1960).

A number of sharp absorption bands in the infrared spectrum crystalline α-quartz between 3200 cm^{-1} and 3655 cm^{-1} have n assigned to defects in the lattice. Defects containing water y cause a broad absorption through this region of the spectrum very imperfect parts of certain crystals, but it does not contri- e to the sharp bands observed. One band at 3581 cm^{-1} is pro- ly due to the OH stretching vibration of a proton defect but other peaks are not. Treatments of the crystal involving irradiation, heat bleaching, annealing or heating in an electric ld strongly affect the intensities of the bands observed, and s concluded that the bands originate in colour centres with an ctronic origin. Probably more than one type of centre is involved. correlation with the visible colour centres of smoky quartz or ethyst is observed. Interstitial foreign atoms play an important e in the formation of the infrared centres but vacancies or inter- tial Si or O atoms are probably not involved. Although much ormation relating to the infrared colour centres is available full details of their strucutre are not yet known.

539.2 : 535.33

16071 **ABSORPTION OF INFRARED RADIATION BY FREE CHARGE CARRIERS IN SILICON.** V.S.Vavilov.
z. tverdogo Tela, Vol. 2, No. 2, 374-7 (Feb., 1960). In Russian.

Reports an investigation (at 295° K) of the absorption of 1-11 μ diation in silicon monocrystals of p- and n-type with free carrier nsities from 10^{14} to 5×10^{17} cm^{-3} and in silicon previously irradi- ed with fast neutrons (carrier density 10^{12} cm^{-3}). Comparison th Fan's theory (Abstr. 8771 of 1956) gave a mean effective hole ass of 3.6×10^{-28} g. It was found that Fan's relationship $\alpha \sim \lambda^{3/2}$ is the absorption coefficient and λ is the wavelength of infrared diation) was not satisfied in n-type crystals and in highly trans- rent p-type crystals. A.Tybulewicz

539.2 : 535.33

16072 **THE RAMAN SPECTRA OF POLYCRYSTALLINE SOLIDS.** D.Krishnamurti.
roc. Indian Acad. Sci. A, Vol. 52, No. 1, 20-6 (July, 1960).

Discusses the experimental techniques with regard to the cording of the Raman spectra of polycrystalline solids. The esent studies on the typical cases of polycrystalline gypsum, d calcite in the form of a finely divided powder show that the asetti technique can be successfully employed to obtain clear ectra of such substances and also indicate the scope for further provements in the techniques. It emerges that the polycrystal- ne nature of the gypsum and the finely divided form of the powder udied have no observable influence on their spectra.

539.2 : 535.33

16073 **REACTOR AND GAMMA-RAY INDUCED COLORING OF CORNING FUSED SILICA.** P.W.Levy.
Phys. Chem. Solids, Vol. 13, No. 3-4, 287-95 (June, 1960).

When crystalline quartz, fused silica and many other substances e subject to reactor or gamma-ray radiations the samples develop optical absorption bands in the region 0.2-1 μ. Usually, there are many broad bands which develop and resolution of the observed spectrum into the component bands is difficult. Corning fused silica is coloured less than all of the materials studied and the observed spectrum can be resolved into its components by properly utilizing the variations in the relative absorption of the different bands created by changing the irradiation conditions. The most intense band is near 5.75 eV (218 mμ) and there is a smaller one at 5.05 eV (242 mμ) when the sample is irradiated in the reactor at 70° C. The 5.05 eV band has, relative to the 5.75 eV band, low intensity when the reactor irradiation is at 170° C but is much stronger when the irradiation is at liquid nitrogen temperature. Also, the peak of the 5.75 eV band shifts slightly with irradiation temperature. The band at 5.05 eV, which can be separated from the other bands without assuming a shape for it, is well fitted by a Gaussian curve and it is assumed that all other bands are similarly shaped. When a sample originally coloured in the reactor is subsequently subjected to gamma-rays, additional absorption bands appear and their intensity is proportional to both the reactor and gamma-ray exposures. In all, new bands at approximately 5.5, 4.5, 2.0 and ~ 6.1 eV (223, 278, 625 and 200 mμ, respectively) are present with indications of four others.

539.2 : 535.33

16074 **GAMMA IRRADIATION OF LEAD SILICA GLASS.** R.S.Barker, D.A.Richardson, E.A.G.McConkey and R.Rimmer.
Nature (London), Vol. 187, 135-6 (July 9, 1960).

The absorption spectra are measured after various doses of gamma radiation up to 10^8 rads. Two processes are indicated, one a trapping of excited electrons in already existent defects and a second involving further defect creation by the bombardment. G.F.J.Garlick

539.2 : 535.37

16075 **DEPENDENCE OF THE POLARIZATION OF LUMINESCENCE OF A SYSTEM OF PARTICLES WITH THREE ENERGY LEVELS ON THE EXCITING LIGHT INTENSITY.**
B.I.Stepanov and V.P.Gribkovskii.
Optika i Spektrosk., Vol. 8, No. 2, 224-31 (Feb., 1960). In Russian.

Reports a calculation of the dependences of the polarization of luminescence, the absorption coefficient, the dichroism, and the intensity of α-phosphorescence on the intensity of radiation incident on a system of particles with three energy levels, i.e. molecules possessing normal, unstable and metastable levels. It was found that all these dependences were nonlinear and were related to accumulation of particles in the metastable level. A.Tybulewicz

539.2 : 535.37

16076 **THE RELATIONSHIP BETWEEN THE RECOMBINATION LUMINESCENCE AND CONDUCTIVITY UNDER NON-ISOTHERMAL CONDITIONS.** K.K.Rebane.
Fiz. tverdogo Tela, Vol. 2, No. 2, 273-4 (Feb., 1960). In Russian.

Extends the author's relationship (Abstr. 9480 of 1959; 1743 of 1960) between the laws of decay and afterglow of the recombination luminescence and decay of the electrical conductivity to non-isothermal conditions. A.Tybulewicz

539.2 : 535.37

16077 **INVESTIGATION OF THE THERMAL ACTIVATION ENERGY OF A LUMINESCENCE FLASH AND THE LOCALIZATION LEVELS IN CaS-BASED PHOSPHORS.**
V.L.Levshin and N.Kh.Faizi.
Optika i Spektrosk., Vol. 8, No. 6, 875-7 (June, 1960). In Russian.

The luminescence flash and thermoluminescence of CaS, CaS:Sm, CaS:Cu, CaS:Bi, CaS:Bi:Ce, CaS:Bi:Eu, CaS;Bi:Pr, CaS:Sm:Cu, CaS:Sm:Ce were investigated. The thermal activation energies of the luminescence flash (energies necessary to transfer electrons from deep levels to more shallow ones so that they produce an optical flash when stimulated with 0.8-1.2 μ infrared light) were found for the CaS:Sm:Cu and CaS:Sm:Ce phosphors. These energies were 0.18 and 0.35 eV respectively for the +30 and +150° C levels of CaS:Sm:Cu and 0.25 eV for the +30° C level of CaS:Sm:Ce.
A.Tybulewicz

539.2 : 535.37

16078 **EXPERIMENTAL STUDIES OF THE LUMINESCENCE OF CADIUM IODIDE ACTIVATED BY LEAD.**
Nguyên Chung-Tú.
Ann Phys. (Paris), Ser. 3, Vol. 5, No. 5-6, 567-613 (May-June, 1960). In French.

A study was first made of the solubility of PbI_2 in aqueous solutions of CdI_2 at various concentrations and temperatures, with a view to preparing homogenous solid materials whose fluorescence was measured under long ultraviolet excitation. PbI_2 dissolved in CdI_2 produces an extra absorption band centered at ~ 3600 A, but the aqueous solutions do not fluoresce. At any temperature between 25 and 65°C the fluorescence of the solid increases linearly with Pb concentration up to 10^{-3}mole per mole CdI_2, then nearly linearly but more steeply up to 4×10^{-3} mole Pb. Between 18 and 158°C the measured emission band shows a decrease in intensity, a change of peak from 5720 to 5818 A, and an increase in breadth. These results are compared with existing formulae for temperature quenching and changes of band-width. The mechanism of the fluorescence is discussed. S.T.Henderson

539.2 : 535.37 : 537.312

16079 SUPERLINEARITY IN THE LUMINESCENCE AND PHOTOCONDUCTIVITY PHENOMENA AND THE ROSE—BUBE THEORY.

N.A.Tolstoi and A.I.Rÿskin.
Optika i Spektrosk., Vol. 8, No. 2, 272-4 (Feb., 1960). In Russian.

An experimental study of the superlinear dependence of luminescence and photoconductivity of CdS on the excitation intensity did not confirm the theory of Rose and Bube (Abstr. 2886 of 1956 and J. Phys. Chem. Solids, Vol. 1, 234, 1957), but the results were in good agreement with the main ideas of the two-step theory of Lashkarev and Fedorus (1952) and Tolstoi (Abstr. 5015 of 1956), which assumes a rise of the quantum yield of electrons transferred to the conduction band with the excitation intensity. A.Tybulewicz

539.2 : 535.37

16080 CHANGE IN STRUCTURE OF BLUE AND GREEN FLUORESCENCE IN CADMIUM SULFIDE AT LOW TEMPERATURES.

L.S.Pedrotti and D.C.Reynolds.
Phys. Rev., Vol. 119, No. 6, 1897-8 (Sept. 15, 1960).

The two fundamental fluorescences observed in CdS crystals subjected to ultraviolet excitation at low temperatures are classified according to wavelength. Photographs of the two fluorescences at 4.2° and 77° K are given, and their structures are compared. Experimental evidence on the change in structure of the green emission near 5130 A between 4.2° K and 77° K is presented and used to confirm an explanation for the apparent "green" shift in CdS proposed by Thomas and Hopfield.

539.2 : 535.37

16081 LUMINESCENCE OF NON-ACTIVATED CsI CRYSTALS. II.

Z.L.Morgenshtern.
Optika i Spektrosk., Vol. 8, No. 5, 672-7 (May, 1960). In Russian.

For Pt I see Abstr. 4440 of 1960. Luminescence of non-activated and In- or Tl-activated CsI crystals, excited with Co^{60} γ-rays, was investigated at room temperature and at the boiling point of liquid nitrogen. In non-activated and activated crystals two bands were observed: a dark blue one (maximum at 403-412 mμ) due to lattice vacancies, and an ultraviolet one (maximum at 319-343 mμ), which was not due to lattice vacancies (nothing definite could be said about the centres responsible for the ultraviolet band). Introduction of an activator produced an activator band (maximum at 535-577 mμ); increase of the activator concentration gradually reduced to zero the intensities of the ultraviolet and the dark blue bands. When CsI crystals were compressed, then (in addition to the dark blue luminescence) a yellow band appeared which was similar in colour to the Tl band. This yellow band was due to structural defects produced by plastic deformation, but the centres responsible for this band were different from the vacancies producing the dark blue band since the latter was not affected by plastic deformation. A.Tybulewicz

539.2 : 535.37

16082 INTRINSIC RECOMBINATION RADIATION IN DIAMOND.

J.C.Male and J.R.Prior.
Nature (London), Vol. 186, 1037-8 (June 25, 1960).

A report on ultraviolet emission from a strongly blue luminescent diamond. The emitted radiation has a number of maxima. The energies are associated with recombinations of excitons having zero velocity with phonon emission. The visible luminescence is concentrated in a small region of diameter 0.1 mm close to the crystal surface. S.Tolansky

539.2 : 535.37

16083 MULTIPLE EMISSION SPECTRA OF TRIVALENT EUROPIUM IN THE SCHEELITE STRUCTURE.

L.G.Van Uitert and R.R.Soden.
J. chem. Phys., Vol. 32, No. 6, 1687-9 (June, 1960).

Spectra resulting from emission from four electronic levels were observed for members of the series $Ca_{1-2X}Na_XEu_XWO_4$. The relative intensities are concentration dependent. Successively lower lying emission levels are quenched by what appear to be exchange interactions resulting from coupling between two or more neighboring Eu^{3+} ions.

539.2 : 535

16084 FLUORESCENCE SPECTRA OF COORDINATED HOLMIUM AND THULIUM IONS.

G.A.Crosby and R.E.W
Naturwissenschaften, Vol. 47, No. 12, 276-7 (1960).

Chelates of Tm^{3+} and Ho^{3+} were excited at 77° K by 3650 A radiation. The fluorescence line wavelengths were found in the blue-green and red for Tm and in the red for Ho. With dibenzoy methide the Ho chelate fluoresced, but those of Tm and Dy did not S.T.Henders

539.2 : 535.

16085 THE STEP-LIKE DEPENDENCE OF THE QUANTUM YIELD OF RECOMBINATION LUMINESCENCE OF ALKALI-HALIDE CRYSTAL PHOSPHORS ON THE FREQUENCY THE EXCITING LIGHT.

I.V.Yaek.
Optika i Spektrosk., Vol. 8, No. 4, 577-9 (April, 1960). In Russian

A step-like dependence of the quantum yield of recombination luminescence on the exciting-light frequency was observed in KBr:In, KCl:In, NaCl:In and KBr:Ga. It was due to the two-step photo-thermal nature of excitation of recombination luminescence A.Tybulewi

539.2 : 535.

16086 A CONTRIBUTION TO THE THEORY OF LUMINESCENCE OF IMPURE CRYSTAL PHOSPHORS.

N.D.Potekhina.
Optika i Spektrosk., Vol. 8, No. 6, 832-8 (June, 1960). In Russian

Williams (Abstr. 4293 of 1951) suggested a method of calculat ing the positions of the luminescence bands of alkali-halide crysta phosphors. The advantage of this method was its comparative sin plicity and the agreement of theoretical predictions with experime results, at least for KCl:Tl. The disadvantage of the method lay i its lack of theoretical justification of the calculation of the impuri centre energies in the excited states. A quantum-mechanical analy of Williams' method in the case of NaCl:Ag showed that the "repul sion energy" of the excited state represents the sum of the S-ener and the exchange energy, and does not include, in contrast to the case of the ground state, the energy of Coulomb overlapping. It w found that Williams' method allows correctly for the displacement the excited level of an impurity ion in the crystal field. The analy proved also that the $4d^{10}$-$4d^9 5p$ transition in silver ions is respons for the luminescence bands of NaCl:Ag. A.Tybulewi

539.2 : 535

16087 ACTIVATOR CENTER IN MAGNESIUM FLUOROGERMANATE PHOSPHORS.

G.Kemeny and C.H.Haa
J. chem. Phys., Vol. 33, No. 3, 783-9 (Sept., 1960).

The Mn^{4+} centre in mainly octahedral symmetry was studied in magnesium fluorogermanate phosphors. Emission and absorpt spectra and the temperature dependence of various parameters w evaluated. Absorption takes place from the $^4A_2$ ground state into $^4F_2$, $^4F_1$, and higher excited states whereas both emission bands, which lie in the red region of the spectrum, correspond to transit from the split $^4F_2$ state to the ground state. Electrons in $^4F_1$ and higher quartet states decay nonradiatively into the $^4F_2$ state. The crystal field parameters Dq for the absorption and emission are 2400 and 1600 cm^{-1}, respectively. The electronic and vibrational structure, the temperature dependence and kinetics of emission c be explained by a configurational (normal) coordinate diagram. T coordinate is associated with the distortions from octahedral symmetry and is thus different from that associated with the octahedral crystal field parameter Dq.

539.2 : 535

16088 THE FLUORESCENCE OF CERTAIN HALOGENATE COMPLEXES OF MANGANESE AND PYRIDINE.

K.Nikolitch, H.P.de la Garanderie and S.Schlivitch.
C.R. Acad. Sci. (Paris), Vol. 250, No. 25, 4143-5 (June 20, 1960) In French.

The green compound $(C_5H_6NH)_2.MnCl_4$ exhibited green fluore cence under long wavelength ultraviolet excitation, and the orang red compounds $MnCl_2.C_5H_5NHCl$ with and without a molecule of H_2O showed orange-red fluorescence. S.T.Hender

539.2 : 535.37

6089 THE EFFECT OF HIGH-TEMPERATURE ANNEALING ON LUMINESCENCE AND COLORATION OF X-RAY ADIATED QUARTZ CRYSTALS.

M.N.D'yachenko.

ka i Spektrosk., Vol. 8, No. 4, 531-6 (April, 1960). In Russian.

Transparent quartz monocrystals of magnetic and thermal in were irradiated with X-rays from a tube working at 150 kV, nA. The irradiation lasted between 30 min and 3 hr at room perature and 15 min at liquid-nitrogen temperature (-196°C). n-temperature annealing (3-10 hr at 500-800°C) intensified the ky colour of X-irradiated crystals, intensified luminescence erally and produced new thermoluminescence peaks, lying veen 200 and 600°K, in the ultraviolet and visible regions; these ks were due to formation of thermal micro-defects (vacancies) redistribution of impurities. A.Tybulewicz

539.2 : 535.37

16090 THE EFFECT OF INFRARED RADIATION ON THE TRANSFER OF ENERGY IN ZnS:Mn.

P.Jaszczyn.

a phys. Polon., Vol. 18, No. 5, 427-38 (1959). In French.

Irradiation with infrared of ZnS:Mn powders under ultraviolet itation at −190°C caused a decrease in intensity of the blue band enhanced the yellow band. Measurements of the dependence of effect on the activator concentration, the thickness of the phos- r layer and the wavelength and intensity of the exciting and infra- radiations, indicated that the infrared radiation affected the rgy transfer mechanism, by the freeing of holes from excited e centres. J.Franks

539.2 : 535.37

6091 THE CALORIMETRIC DETERMINATION OF THE EFFICIENCY OF ZnS-TYPE LUMINESCENT TERIALS.

G.Gergely.

a. phys. Hungar., Vol. 7, No. 1, 171-4 (1957).

A microcalorimeter incorporating thermistors was used to asure the luminescence efficiency of ZnS:Ag powders excited by 0 A radiation. Quantum efficiencies of 89-94% were obtained for agonal and cubic ZnS:Ag specimens, and 54.5% for a 50 S—50 CdS:Ag specimen. J.B.Birks

539.2 : 535.37

16092 SOME EFFECTS OBSERVED IN AN INVESTIGATION OF THE LUMINESCENCE OF ELECTRETS MADE OF ZnS.

M.Fridkin.

kl. Akad. Nauk SSSR, Vol. 131, No. 2, 290-2 (March 11, 1960). Russian.

It was found that the luminescent luminance was changed by the esence of a field. On warming the specimens an analogue of rmoluminescence was observed in the degree of electric polar- tion. These phenomena were considered in terms of the tunnel ect occurring in the specimens. K.N.R.Taylor

539.2 : 535.37

16093 POLARIZATION OF LUMINESCENCE OF ZnS MONO-CRYSTALS.

V.I.Gribkov and N.D.Zhevandrov.

tika i Spektrosk., Vol. 8, No. 2, 275-6 (Feb., 1960). In Russian.

Reports a study of the polarization of luminescence of ZnS nocrystals activated with copper. The azimuthal dependence and maximum degree of polarization (20%) were found to be independ- t of the excitation wavelength (436, 405, 365 and 313 mμ). The larization of luminescence was independent of the polarization of exciting light due to migration of the excitation energy (an ex- on or an electron—hole mechanism) across the crystal. The larization was constant throughout the luminescence spectrum and rglow had the same degree of polarization as the luminescence ring excitation. A.Tybulewicz

539.2 : 535.37

16094 THE EFFECT OF TEMPERATURE ON PHOTO-LUMINESCENCE OF THE SUBLIMATED PHOSPHOR S:Mn.

N.A.Vlasenko.

tika i Spektrosk., Vol. 8, No. 6, 847-54 (June, 1960). In Russian.

The effect of temperature on the absorption and luminescence ectra of the sublimated phosphor ZnS:Mn was investigated between 0° and 550°K and the temperature dependence of the relative quan- m yield of luminescence was obtained for samples with amounts of from 0.05 to 5%. The results obtained were used to reduce the echanism of excitation of luminescence centres, the nature of minescent and radiationless transitions and the kinetics of concen- tion quenching. A.Tybulewicz

539.2 : 535.37

16095 A PYROMETRIC APPLICATION OF THE PHOTO-LUMINESCENCE OF ZnS:Cu EXCITED BY ULTRA-VIOLET RADIATION (366 mμ) MODULATED AT A FREQUENCY OF 100 c/s.

P.Thureau and J.P.Leroux.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4301-3 (June 27, 1960). In French.

The emission of a ZnS:Cu phosphor under a Wood's glass lamp is modulated at 100 c/s, and the relation between the degree of modulation and the mean level of emission varies with the intensity of excitation, the layer thickness, and the temperature. From oscilloscope measurements of the emission and a family of curves drawn for different values of the first two parameters, the temperature of the sample may be determined. S.T.Henderson

539.2 : 535.37

16096 GOLD-ACTIVATED (Zn, Cd)S PHOSPHORS.

M.Avinor.

J. Electrochem. Soc., Vol. 107, No. 7, 608-11 (July, 1960).

Gold is shown to produce three emission bands in CdS at 640, 800 and 1150 mμ. The long-wave band appears only when a coactivator is used while the short-wave bands are observed with activation by gold alone. The 1150 mμ band in CdS is shown to correspond to the 530 mμ gold band in ZnS.

539.2 : 535.37

16097 THE EFFECT OF TEMPERATURE ON INFRARED QUENCHING.

K.S.K.Rebane and É.Sakarinen.

Optika i Spektrosk., Vol. 8, No. 4, 545-9 (April, 1960). In Russian.

Dependence of the infrared quenching of green luminescence on temperature (300-550°K) was studied at two excitation wavelengths (365 and 313 mμ) on nine ZnS phosphors containing various amounts of Cu, Fe, NaCl and ZnO. The infrared quenching was defined as $\mu = (I_0 - I)/I_0$, where I_0 and I are the intensities of luminescence before and after irradiation with infrared light. The observed non-monatomic variation of the infrared quenching with temperature was due to the specific nature of the capture-level spectra of the phosphors and due to the simultaneous de-excitation produced by rising temperatures and infrared light. A temperature quenching "hysteresis" was observed: on cooling the intensity of luminescence did not return to its original value but remained 2-3 times weaker and the temperature quenching curve obtained by cooling differed from that obtained by heating. A.Tybulewicz

539.2 : 535.37

16098 THE QUANTUM YIELD OF FLUORESCENCE OF CERTAIN SUBSTANCES IN POLYSTYRENE.

E.A.Andreeshchev and I.M.Rozman.

Optika i Spektrosk., Vol. 8, No. 6, 828-31 (June, 1960). In Russian.

An experimental technique of measuring the quantum yields of fluorescence is described and the results are given for eight organic compounds in polystyrene. First the quantum yield of 2,5-diphenyl-1,3-oxazole (2PO) was found to be 0.80 ± 0.05. Next the yields of the other seven compounds were found relative to that of 2PO. These yields were: 0.66 ± 0.08 for 2,5-diphenyl-1,3,4-oxydiazole, 0.42 ± 0.06 for acenaphthene, 0.75 ± 0.08 for n-terphenyl, 0.73 ± 0.07 for 1,1,4,4-tetraphenyl-1,3-butadiene, 0.74 ± 0.07 for 1,3,5-triphenyl-Δ^2-pyrazoline, 0.76 ± 0.10 for 1,3,4-triphenyl-Δ^2-pyrazoline, 0.84 ± 0.08 for 4-styrylstilbene. A.Tybulewicz

539.2 : 535.37

16099 SINGLET→TRIPLET TRANSITION IN PARA-CHLOROTOLUENE.

J.K.Roy.

Indian J. Phys., Vol. 33, No. 5, 209-12 (May, 1959).

The luminescence spectra excited in parachlorotoluene was studied using monochromatic radiations of different wavelengths. It was observed that such a radiation of wavelength as large as 3750 A excites the luminescence bands. As the near ultraviolet absorption band due to singlet→singlet* transition in this case is at 2760 A it has been concluded that the observed luminescence is produced by absorption of the radiation due to the singlet→triplet transition and that the selection rule is violated in this case owing to the particular type of substitution.

539.2 : 535.37

16100 THE CONCENTRATION DEPOLARIZATION OF PHOSPHORESCENCE OF ORGANIC PHOSPHORS.

P.I.Kudryashov and B.Ya.Sveshnikov.

Optika i Spektrosk., Vol. 8, No. 5, 651-6 (May, 1960). In Russian.

An investigation of the concentration depolarization of the total emission (luminescence) and of phosphorescence of fluoroscein-activated boron—glycerine phosphors at 20°C and at -186°C showed

that: (1) the degree of polarization of a narrow spectral region of phosphorescence does not change during decay of the afterglow; (2) at room temperature the concentration depolarization of luminescence is smaller than a similar depolarization of phosphorescence; (3) at low temperatures the concentration depolarization of phosphorescence is smaller than the depolarization of fluorescence; (4) the results obtained at low temperatures (but not those obtained at room temperature) contradict the current ideas of the mechanism of molecular transitions in the phosphorescent states and of the mechanism of the concentration depolarization of fluorescence.
A.Tybulewicz

539.2 : 535.37

16101 EFFECT OF DEUTERIUM SUBSTITUTION ON THE LIFETIME OF THE PHOSPHORESCENT TRIPLET STATE OF NAPHTHALENE.

H.Sternlicht and H.M.McConnell.
J. chem. Phys., Vol. 33, No. 1, 302-3 (July, 1960).

The increase in phosphorescence lifetime from 2.1 to 16.9 sec at 77° K when protons were replaced by deuterons (See Abstr. 10231 of 1960) is explained by mixing of singlets and triplets by hyperfine interactions. The ratio of lifetimes had the same order of magnitude as the predicted ratio of average square nuclear magnetizations. It is shown that the lifetimes are, under the low temperature conditions, independent of the spin state representation unless spin—orbit interaction contributes to mixing of states.
G.F.J.Garlick

539.2 : 535.37

16102 RESPONSE SPECTRA FOR GAMMA RAYS IN CsI.

W.F.Miller and W.J.Snow.
Rev. sci. Instrum., Vol. 31, No. 8, 861-2 (Aug., 1960).

Response spectra for gamma rays incident on cesium iodide (thallium-activated) crystals have been calculated for two crystals. The crystals considered are right circular cylinders and the gamma-ray energies are 0.661, 1.83, 2.76, and 3.13 MeV. Comparisons between the response spectra for CsI:Tl and NaI:Tl crystals of the same size are presented.

539.2 : 535.37 : 539.1.07

16103 THE EFFICIENCY AND MAIN DECAY TIME OF CsI(Tl) FOR ELECTRONS AND ALPHA PARTICLES IN CRYSTALS WITH DIFFERENT THALLIUM CONCENTRATIONS.

D.A.Jones and A.Ward.
Proc. Phys. Soc., Vol. 75, Pt 6, 931-3 (June, 1960).

It is known that the main decay time in CsI:Tl varies with the density of ionization produced by the bombarding particle — an effect which may be useful in some experiments since it allows a degree of mass selection in measuring energy spectra. To examine whether the magnitude of the effect could be increased by varying the thallium concentration the authors have grown CsI crystals with different concentrations of thallium and have measured the efficiency and main decay time for electrons and alpha particles. The results show that in practice there appears to be no advantage for mass selection on changing the thallium concentration from the value in the standard Harshaw crystal.
C.F.Barnaby

539.2 : 535.37

16104 SPECTROSCOPY OF THE LUMINESCENCE CENTRES IN ALKALI-HALIDE CRYSTALS ACTIVATED WITH HOMOLOGOUS SERIES OF IONS.

N.E.Lushchik and Ch.B.Lushchik.
Optika i Spektrosk., Vol. 8, No. 6, 839-46 (June, 1960). In Russian.

Discusses "direct activation" of NaCl, KCl, KBr and KI crystals (in "direct activation" the luminescence centres retain many characteristics of free ions). The following ions were found to produce "direct activation": Ga$^+$, Ge^{++}, In$^+$, Sn^{++}, Tl$^+$, Pb^{++}, Cu$^+$, Ag$^+$, Au$^+$, Ca$^+$, Sr$^+$, Ba$^+$, Zn$^+$, Cd$^+$. It is suggested that direct activation with other ions (e.g. Sc$^+$, Ti^{++}, V$^+$, Zr^{++}, La^{++}, Hf^{++}) is also possible, at least in principle.
A.Tybulewicz

539.2 : 535.37

16105 ACTION OF ELECTRIC FIELDS ON THE LUMINESCENCE OF SCINTILLATIONS.

J.Messier and J.Mattler.
C.R.Acad. Sci. (Paris), Vol. 250, No. 23, 3822-4 (June 8, 1960). In French.

Scintillations due to alpha-particles in some sulphides (e.g. ZnS-Cds-Mn) were apparently enhanced by a.c. fields of 1000 V/cm. The gain is about 35% for such fields at 50 c/s frequency. Detailed studies show that the maximum amplitude of the light pulses is not affected, but that the field enhances the background pulses following each scintillation.
G.F.J.Garlick

539.2 : 535.

16106 PROPERTIES OF ZnS:Mn:Ni:Cl EXCITED WITH ELECTRONS.

A.I.Blazhevich, A.G.Zavrazhin and A.V.Lavrov.
Optika i Spektrosk., Vol. 8, No. 4, 550-3 (April, 1960). In Russian.

Reports an investigation of the effect of Ni ($10^{-7}-10^{-4}$ g/g) on the fluorescence and on the decay of phosphorescence of ZnS:Mn:Cl phosphors excited with electron beams of $10^{-7}-10^{-8}$ A/c densities and 10-50 keV energies. Both at room temperature and at −132° C, the increase of Ni concentration produced a gradual weakening of the hyperbolic component and an intensification of the exponential component in the decay of phosphorescence. With 10^{-5} g/g Ni the intensity of fluorescence rose but a further increas of the amount of Ni reduced this intensity. Introduction of Ni did not affect the luminescence spectrum. Thermoluminescence curve showed that the light sum stored at all capture levels decreased with increase of the Ni concentration; when the amount of Ni reach 10^{-4} g/g the stored light sum was reduced practically to zero. Introduction of Ni in the absence of Cl in the phosphor always quenched luminescence and the decay curves were exponential and unaffected by the amount of Ni.
A.Tybulewic

539.2 : 535.37 : 532

16107 THE MECHANISM OF SCINTILLATIONS IN ORGANIC SUBSTANCES. I.

I.M.Rozman.
Optika i Spektrosk., Vol. 8, No. 4, 525-30 (April, 1960). In Russia

Reviews the existing theories and then suggests a theoretical treatment which takes into account the local activation (excitation and ionization) density, especially the presence of "isolated" activations in the tracks of heavy particles (e.g. α-particles) and the presence of "accumulations" of activated molecules in the tracks fast electrons.
A.Tybulewi

539.2 : 535.

16108 ORIGIN OF LOCAL HIGH ELECTRIC FIELD IN ELECT LUMINESCENCE.

K.Maeda.
Physica, Vol. 25, No. 8, 721-2 (Aug., 1959).

Zalm's model for electroluminescence, in which the phosphor grains are completely covered by a conducting layer, is not in agreement with experiment, in particular because of the lack of excitation when the short axis of a grain is parallel to the applied field. It is considered that excitation occurs at the edge of discontinuous conducting layers on the grains.
S.T.Henders

539.2 : 535.

16109 THE POLARIZATION PHENOMENA IN ELECTROLUMINESCENT PHOSPHORS.

A.M.Bonch-Bruevich and O.S.Marenkov.
Optika i Spektrosk., Vol. 8, No. 6, 855-60 (June, 1960). In Russian

Describes a study of the rapid polarization processes and electroluminescent flashes in the ZnS:Cu:Al phosphor excited with pulses (polarization is used here in the sense of electric charge accumulation or separation). It was found that the electric field du to rapid polarization (there is also long-duration polarization) is established in 10-20 μsec, i.e. during a time interval several orde smaller than the decay time of electroluminescence. Analysis of t kinetics of electroluminescence decay led to the conclusion that quenching is produced by the polarization field acting in the direct opposite to the external field.
A.Tybulewi

539.2 : 535.

16110 ZnS:Cu, Cl AND (Zn,Cd)S:Cu, Cl ELECTROLUMINESCENT PHOSPHORS.

A.Wachtel.
J. Electrochem. Soc., Vol. 107, No. 7, 602-8 (July, 1960).

Procedures for a method of preparation of these phosphors are based on firing in an atmosphere containing elementary S. Cl-incorporation is controlled by firing in capped silica tubes or in open boats in a current of $N_2 + S_2Cl_2$. Dependence of brightness on activator concentration is established on the basis of presumab constant excess Cu as Cu_2S. The use of Pb was found to be disadvantageous. Introduction of Cd causes the formation of the hexagonal phase and a (Cu,Cd)S compound, and the simultaneous decre of electroluminescence brightness, as well as the dependence of electroluminescence emission colour on Cd concentration. A two-step firing procedure is given by means of which this effect may b partially avoided.

539.2 : 535.

16111 TOTAL LUMINANCE OF LUMINESCENCE OF ZnS:Cu AND ZnS:Cu:Mn PHOSPHORS IN PULSATING FIELDS.

G.S.Kozina and L.P.Poskacheeva.
Optika i Spektrosk., Vol. 8, No. 2, 214-17 (Feb., 1960). In Russia

Reports measurements of the total luminance of electro- inescence of green (ZnS:Cu) and yellow (ZnS:Cu:Mn) phosphors ted with unipolar sinusoids and square pulses. Luminance of yellow phosphors in pulsating fields (B_p) was found to be several es greater than their luminance in two-directional (ordinary) fields (B_{ac}), and these high values of B_p were accompanied by ge currents through the samples. The difference between B_p and was considerably reduced with rise of frequency. Luminance of green phosphors in pulsating fields was slightly smaller than in -directional fields. The difference between the behaviour of the low and green phosphors is due to the fact that the former lumin- e in d.c. fields and are consequently affected by the d.c. compo- t of the pulsating field. See also following abstract.

A.Tybulewicz

539.2 : 535.37

16112

LUMINANCE (BRIGHTNESS) WAVES OF ELECTROLUMINESCENCE UNDER THE CONDITIONS OF MULTANEOUS ACTION OF D.C. AND A.C. FIELDS.

.Kozina, V.N.Favorin and I.D.Anisimova.

tika i Spektrosk., Vol. 8, No. 2, 218-23 (Feb., 1960). In Russian.

Reports an investigation of green (ZnS:Cu) and yellow S:Cu:Mn) phosphors excited simultaneously with a.c. and d.c. tages. The a.c. voltages were either square pulses of 100 c/s usoids. Distortions of the luminance waves observed in the low phosphors were due to superposition of the non-additive ects of d.c. and a.c. fields. No distortions of the luminance waves re observed in the green phosphors on simultaneous application a.c. and d.c. fields.

A.Tybulewicz

539.2 : 535.37

16113

"ANISOTROPY" OF A LUMINANCE WAVE FROM A POLARIZED ELECTROLUMINESCENT CELL.

.L.Rabotkin and V.A.Sokolov.

ptika i Spektrosk., Vol. 8, No. 2, 276-7 (Feb., 1960). In Russian.

A polarized electroluminescent cell was prepared by solidifying suspension of ZnS : Cu : Pb in molten paraffin wax between two ectrodes with 2000 V d.c. across them. A cell prepared in this way as excited with periodic unipolar pulses. If the polarity of the ılses coincided with the polarity of the field used to prepare the cell, en the luminance (brightness) wave had two approximately equal eaks in each period. When the pulse polarity was opposite to that the field used to prepare the cell, the second of the luminance eaks became narrower and higher than the first. This effect was oserved both in a freshly prepared cell and several days after its reparation.

A.Tybulewicz

539.2 : 535.37

16114

(Zn,Hg)S AND (Zn,Cd,Hg)S ELECTROLUMINESCENT PHOSPHORS. A.Wachtel.

Electrochem. Soc., Vol. 107, No. 8, 682-8 (Aug., 1960).

Solid solutions of (Zn,Hg)S prepared by firing in sealed silica bes are cubic in structure. With suitable additions of Cu and a oactivator, photoluminescence and electroluminescence are ob- ined. The coactivators used were halides, Ga or In. The electro- minescence in the red consists of two emission bands which do not ppear to be analogous to the blue and green emission bands of Cu, l in ZnS. The quantum efficiency is of the same order of magnitude s that of ZnS:Cu, Cl, but the emission bandwidth is about twice as rge and the red electroluminescence consists of emission located a large extent in the infrared. HgS tends to retain the cubic ructure of ternary (Zn, Cd, Hg)S systems provided that the Cd/Hg atio does not exceed certain limits; until this is so, the introduction Cd causes increased electroluminescence.

539.2 : 535.37

16115

THE EFFECT OF TEMPERATURE ON ELECTROLUMINESCENCE OF A SUBLIMATED PHOSPHOR nS:Mn.

N.A.Vlasenko.

ptika i Spektrosk., Vol. 8, No. 3, 414-17 (March, 1960). In Russian.

Reports studies of the thermoluminescence and of the tempe- ature dependences between 100 and 500°K of the electrolumines- ence, photoluminescence and electrical conductivity. The sharp se of the electroluminescence and the fall of the photoluminescence oove 300°K are explained in terms of donor-level kinetics.

A.Tybulewicz

539.2 : 535.37

16116

THE EFFECT OF ADSORPTION OF GASES ON ELECTROLUMINESCENCE. I.K.Vereshchagin.

ptika i Spektrosk., Vol. 8, No. 3, 420-1 (March, 1960). In Russian.

Electroluminescence of ZnO was found to be affected by the ambient medium (air or vacuum) and ultraviolet radiation. The observed effects are interpreted in terms of oxygen adsorption and desorption.

A.Tybulewicz

539.2 : 535.37

16117

DEFECTS IN NATURAL AND SYNTHETIC QUARTZ. G.W.Arnold, Jr.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 306-20 (June, 1960).

Thermoluminescence measurements of quartz (both irradiated and naturally coloured) have been made from room temperature to 375°C. Various peaks of the light intensity versus temperature curves have been identified with absorption maxima in the 190-1000 m μ spectral region. The method is extremely sensitive to radiation dose; well-defined peaks being observed for very short X-irradiation times (~ 1 sec). Data are presented on X-irradiated natural quartz, smoky quartz and on X-irradiated synthetic quartz with various additives.

539.2 : 535.37

16118

THERMOLUMINESCENCE AND LOCALIZATION LEVELS OF ZnS:Mn PHOSPHORS.

V.L.Levshin and V.F.Tunitskaya.

Optika i Spektrosk., Vol. 8, No. 5, 663-71 (May, 1960). In Russian.

The structure, population and thermal de-excitation (thermoluminescence) of capture levels in ZnS:Mn crystals (with 10^{-6} to 10^{-2} gMn/g ZnS) of sphalerite structure were studied in a wide range of temperatures using exciting light of various wavelengths and intensities. The effect of increasing the manganese concentration on the spectrum of levels was also studied.

A.Tybulewicz

539.2 : 535.37

16119

MECHANICALLY-EXCITED EMISSION IN CADMIUM SULFIDE. D.M.Warschauer and D.C.Reynolds.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 251-6 (June, 1960).

The phenomenon of radiative emission obtained by mechanical excitation of optically or thermally stimulated cadmium sulphide is described and discussed in terms of the recently proposed band structure of the material and the existence of trapping levels in the forbidden-gap region.

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2 : 621.318.1

16120

SUMMARIZED PROCEEDINGS OF A CONFERENCE ON SOME ASPECTS OF MAGNETISM, SHEFFIELD, SEPTEMBER 1959. R.S.Trebble and D.E.G.Williams.

Brit. J. appl. Phys., Vol. 11, No. 8, 307-13 (Aug., 1960).

The following subjects were discussed at this conference which was held at Sheffield University by the Institute of Physics: (1) the behaviour of ferrites and some alloys; (2) domain effects and thin films; (3) domains; (4) neutron diffraction; (5) permanent magnet materials.

539.2 : 538.2

16121

THE DE HAAS–VAN ALPHEN EFFECT IN COPPER, SILVER AND GOLD. D.Shoenberg.

Phil. Mag. (Eighth Ser.), Vol. 5, 105-10 (Feb., 1960).

Measurements suggest strongly that the Fermi surfaces of these metals make contact with the hexagonal faces of the Brillouin zone. The areas of cross-section of the main part of the Fermi surface and of the contact have been determined. Some provisional values of effective masses are also obtained.

539.2 : 538.2

16122

THE g-FACTOR AND DE HAAS–VAN ALPHEN EFFECT OF ELECTRONS IN BISMUTH.

M.H.Cohen and E.I.Blount.

Phil. Mag. (Eighth Ser.), Vol. 5, 115-26 (Feb., 1960).

A theory of the g-factor of conduction electrons is developed which is valid for low symmetry and arbitrary strength of spin–orbit coupling. Application to bismuth shows that $m_s \equiv 2/g \cong m_0$ for most orientations, where m_0 is the effective mass entering the cyclotron frequency. Thus g is 260 when H is in the direction of smallest m_0. Further, the lifting of the spin degeneracy by the magnetic field introduces a factor $\cos r\pi m_0/m_s$ into the r-th oscillatory term in the susceptibility. This explains the apparent phase shift of $r\pi$ observed in the de Haas–van Alphen oscillations of Bi.

539.2 : 538.2

16123 SPIN SPLITTING OF THE LANDAU LEVELS IN BISMUTH OBSERVED BY MAGNETOTHERMAL EXPERIMENTS.

W.S.Boyle, F.S L.Hsu and J.E.Kunzler.
Phys. Rev. Letters, Vol. 4, No. 6, 278-80 (March 15, 1960).

De Haas—van Alphen type oscillations in the electronic specific heat are reported and interpreted to give information on the spin splitting of the Landau levels. It is concluded that with the magnetic field along a binary axis, the ratio of the spin splitting to the Landau spacing is 0.92. This is consistent with the electron resonance experiments of Smith, Galt and Merritt (Abstr. 16163 of 1960).

D.M.Edwards

539.2 : 538.2

16124 MAGNETIC EFFECTS OF TRANSITION METAL IMPURITIES IN ALUMINIUM.

M.A.Taylor, J.P.Burger and J.Wucher.
J. Phys. Radium, Vol. 20, No. 10, 829-30 (Oct., 1959). In French.

Reports results of measurements up to 300°K of the change $\Delta\chi$ of the susceptibility of aluminium containing up to 0.68% Mn, 0.32% Cr and 0.20% V in solid solution; $\Delta\chi$ varies linearly with impurity content but differs from that based on simple additivity considerations.

E.P.Wohlfarth

539.2 : 538.2

16125 ON THE MAGNETIC BEHAVIOUR OF ALUMINIUM AND ALUMINIUM SOLID SOLUTIONS.

R.Lingelbach and E.Vogt.
Acta metallurgica, Vol. 7, No. 7, 441-5 (July, 1959). In German.

Measurements of susceptibility of aluminium between 67°K and 293°K showed a behaviour which is to be expected for the paramagnetism due to the spins of the conduction electrons. Extrapolation of χ to $T = 0$ yields a value for the density of states $N(E_0)$ at the Fermi surface which agrees surprisingly well with the theoretical calculations of Matyas and with the value that can be derived from the measured specific heat of the electrons. On the other hand χ decreases with increasing temperature more rapidly than one would expect according to the $N(E)$ function of Matyas. The changes of χ by addition of other metals as measured by Auer are employed in the discussion. Manganese in dilute solid solution in Al gives rise to a strong additional paramagnetism which does not show the temperature dependence that is generally observed at low Mn concentrations.

539.2 : 538.2 : 536.6

16126 MAGNETIC SUSCEPTIBILITY, HEAT CAPACITY AND THIRD-LAW ENTROPY OF $MgNi_2$.

J.S.Wollam and W.E.Wallace.
J. Phys. Chem. Solids, Vol. 13, No. 3-4, 212-20 (June, 1960).

A study of the heat capacity and magnetic susceptibility of $MgNi_2$ was undertaken to evaluate the report by Voss that this compound is ferromagnetic at temperatures below 235°C. The results of the investigation reveal no evidence of ferromagnetism in this Laves phase. $MgNi_2$ is found to be a moderately strongly paramagnetic material with a susceptibility which is practically constant between 25 and 450°C. Thermomagnetic analysis shows a very slight but abrupt drop in the susceptibility at 194°C, and heat-capacity measurements reveal a very small thermal anomaly at the same temperature. The effects are thought to be associated with some type of irregularity in the lattice, such as the defect structure which occurs when a nickel atom replaces a magnesium atom in the $MgNi_2$ lattice. Third-Law entropies of $MgNi_2$ at temperatures up to 555°K are also presented.

539.2 : 538.2

16127 THE MAGNETIC BEHAVIOURS OF TITANIUM CAESIUM SULPHATE ALUM.

A. Bose, A.S.Chakravarty and R.Chatterjee.
Indian J. Phys., Vol. 33, No. 7, 325-8 (July, 1959).

A new theory for titanium caesium alum is given. The crystalline field is treated using the molecular orbital method of Stevens and others (Abstr. 603 of 1954) as the usual electrostatic field theory fails to explain the magnetic behaviour. It is proposed that the spin—lattice relaxation follows a "Raman Process" at all temperatures between 300°K to 1.2 K. Experimental susceptibility data between 300°K and 100°K as well as the paramagnetic resonance data at 2.5°K can all be accounted satisfactorily by assuming that the trigonal field splitting changes from $-800\ \mathrm{cm}^{-1}$ to $-165\ \mathrm{cm}^{-1}$, with temperature, which is also indicated by the large observed increase in the spin—lattice relaxation time from 300°K to 1.2°K.

539.2 : 538

16128 THE MAGNETIC SUSCEPTIBILITY OF SEMICONDUCTING COMPOUNDS OF THE TERNARY SYSTEM.

M.Matyáš.
Czech. J. Phys., Vol. 10, No. 1, 52-8 (1960). In German.

An attempt to extend the empirical relationships derived for the magnetic susceptibility of binary systems to ternary semiconducting compounds is checked against the Zn—Cd—Sb and In—Ga—Te systems and some solid solutions of other semiconduct compounds. Where the susceptibilities of the components of a ternary system behave additively, it is possible to determine whet a solid solution is present or a new phase has been formed.

G.C.William

539.2 : 538

16129 ON THE APPROACH TO EQUILIBRIUM OF SPIN WAVES SYSTEM. I.

J.Morkowski.
Acta Phys. Polon., Vol. 19, No. 1, 3-20 (1960).

Calculates the spin—spin relaxation time in ferromagnetics caused by pseudo-dipolar interactions between spins. Calculations are based on the spin wave theory in the form given by Dyson (195 The non-Hermitian Hamiltonian in the ideal model of spin waves system is derived and transition probabilities in first approximati are calculated. In this approximation it appears that the processe of the splitting of one spin wave into two (and the confluence of two into one) and of the mutual scattering of two spin waves are the on possible ones. The kinetic equation, taking into account these processes, is derived and the relaxation time is determined. Numeri values of the relaxation time for spin waves with zero wave vector are calculated, showing that the contribution to the line width of ferromagnetic resonance absorption from such spin waves is not important.

539.2 : 538

16130 QUASI-CLASSICAL THEORY OF AMORPHOUS FERROMAGNETICS.

A.I.Gubanov.
Fiz. tverdogo Tela, Vol. 2, No. 3, 502-5 (March, 1960). In Russian

The possibility of the existence of amorphous ferromagnetic substances is considered by an extension of the so-called quasi-classical method. This was first used by Fowler and Guggenheim and applied to ferromagnetics by Stil'bans and by Vonsovskii and Shur. The substance is supposed to contain various kinds of atoms but only one kind is responsible for the ferromagnetism. An expressi for the free energy is calculated, and from this the Curie temperat is derived. In the special case of a one-dimensional crystal, the Curie temperature is not zero, and hence, in contradiction to prev views such a crystal can be ferromagnetic. See Abstr. 3804 of 193 and 309 of 1940. Vonsovskii and Shur, Ferromagnetism (1948); an Fowler and Guggenheim Statistical Mechanics (1949).

N.Da

539.2 : 538.

16131 THE VARIATIONS OF MAGNETIZATION IN THE RAYLEIGH DOMAIN, DUE TO HEATING OR COOLING.

O.Yamada.
C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4313-15 (June 27, 1960). In French.

In the Rayleigh region of the initial magnetization curve, heati or cooling always leads to an irreversible increase in magnetizatio The magnitude of the change depends only on the amplitude of the thermal change and not on its sign.

D.J.Olive

539.2 : 538.

16132 ON THE THEORY OF MAGNETIC ANISOTROPY OF FERROMAGNETIC CRYSTALS.

L.Kowalewski.
Acta phys. Polon., Vol. 19, No. 1, 59-84 (1960).

Using the second quantization method of Holstein—Primakoff a Tyablikov, the following are calculated: (1) the magnetic field valu and direction dependence of energy of crystals with no spin wave excitation; (2) the magnetic field value and direction dependence of dispersion formulae; (3) the temperature and magnetic field value and direction dependence of free energy and of crystal magnetic anisotropy constants. These calculations are performed for simpl body-centered and face-centered cubic lattices as well as for simp hexagonal and closely packed hexagonal lattices.

539.2 : 538.

16133 ANISOTROPY OF THE INTRINSIC DOMAIN MAGNETIZATION OF A FERROMAGNET.

S.H.Charap.
Phys. Rev., Vol. 119, No. 5, 1538-42 (Sept. 1, 1960).

The effect of pseudodipolar coupling on the intrinsic domain gnetization of a cubic ferromagnet at low temperatures is investi- ed. Besides the anisotropy in the magnetization resulting from t dependence of the thermal excitation of spin waves on magneti- ion direction in the crystal, the pseudodipolar coupling is capable making an anisotropic contribution to the magnetization, even at = 0°K, in the same approximation as its contribution to the first- ler anisotropy constant K_1. Both effects are calculated and found be in opposition to one another, tending to cancel in nickel at about °K.

539.2 : 538.2

16134 SINGLE-DOMAIN PARTICLES: NEW USES OF OLD THEOREMS.

W.F.Brown, Jr.

ıer. J. Phys., Vol. 28, No. 6, 542-51 (Sept., 1960).

This article describes some applications of potential theory and ıssical dynamics to one field of current research, the theory of ıgnetization processes in "hard" magnetic materials. Many such ıterials owe their magnetic properties to the fact that they are mposed of fine ferromagnetic particles separated by less magnetic gions. In very fine particles, the exchange forces responsible for spontaneous magnetization keep it uniform in direction within y one particle; the magnetization curve is then determined by tations of the particle magnetizations. The rotations are controlled the interplay of external magnetic energy and of internal energy, so largely magnetic. A first step in the theory is therefore the rivation of a general formula for the internal magnetic energy. mplifications can then be made because of the uniformity of agnetization of each particle; in particular, it can be shown that particle of arbitrary shape is equivalent to an ellipsoid. Calcula- on of static hysteresis loops requires consideration of stability nditions; analysis of magnetization reversals and of the behaviour microwave fields involves the dynamics of gyroscopic systems.

539.2 : 538.2

16135 DOMAIN TUBE STRUCTURES IN SILICON IRON.

L.F.Bates and R.Carey.

roc. Phys. Soc., Vol. 75, Pt 6, 880-4 (June, 1960).

Following a theoretical discussion of Néel spike formation by the xtension and subsequent collapse of a domain tube which joins an ıclusion to a domain wall, a quantitative study was made of the henomena. The results are discussed in terms of a formula given y Brenner (Abstr. 9757 of 1955), and an attempt is made to assess he importance of the phenomena in the explanation of coercivity.

539.2 : 538.2

16136 MOVEMENT OF BLOCH WALLS IN ULTRASONIC FIELDS.

G.Haacke and J.Jaumann.

. angew. Phys., Vol. 12, No. 7, 289-97 (July, 1960). In German.

Reports results of hysteresis-curve and powder-pattern nvestigations on (110) surfaces of a nickel crystal as affected by he application of magnetic fields or ultrasonic vibrations. The 180° lomain walls exhibit Barkhausen jumps which are reduced by the ibrations.

E.P.Wohlfarth

539.2 : 538.2

16137 EXPERIMENTAL STUDY OF THE CRITICAL SCATTERING OF NEUTRONS IN IRON.

M.Ericson and B.Jacrot.

. Phys. Chem. Solids, Vol. 13, No. 3-4, 235-43 (June, 1960). In French.

The cross-section for critical scattering of slow neutrons by ron near the Curie temperature is studied. The parameters κ_1, μ_1, introduced in Van Hove's theory are measured for various tempera- ures. For instance, at a temperature of 826° C($T - T_C = 56°$) one inds that $\kappa_1^2 = 1.66 \times 10^{-2}(A)^{-2}$, and $2\Lambda m/h = 3.5$. The results for $_1$ and μ_1 disagree with the results of other authors. They are con- istent with magnetic data. The results are compared with different heoretical estimations. The best fit is obtained with a model in hich the second neighbours of an iron atom are magnetically active nd in which the magnetic electrons are described by the Heisenberg odel.

539.2 : 538.2

16138 MAGNETIC SCATTERING OF NEUTRONS BY EXCHANGE-COUPLED LATTICES.

A.W.Saenz.

Phys. Rev., Vol. 119, No. 5, 1542-59 (Sept. 1, 1960).

The magnetic scattering of slow neutrons of arbitrary initial olarization by an extensive class of magnetically-coupled lattices s treated by a time-dependent operator approach for the case of complete orbital quenching of the magnetic ions. This magnetic scattering is carefully divided into purely magnetic and magneto-vibrational scattering, the types thereof involving, respectively, only zero-phonon processes and solely nonzero-phonon processes, and general formulae for these two types of scattering are obtained. These formulae are applied in temperature regions which are sufficiently large (I) or sufficiently small (II) compared with the temperature above which paramagnetism obtains. In region I, for the purely magnetic scattering and under certain invariance requirements on the above magnetic coupling, the energy spectrum of outgoing unpolarized neutrons of sufficiently high incident energy is analysed by a moment method. General formulae are thus obtained for the energy-integrated effective differential cross-section defined in this paper and for the moments of energy transfer also defined. These formulae involve certain spin averages, explicit equations being for a wide range of these averages for exchange-coupled lattices. These results are illustrated numerically and compared with experiment for the case of polycrystalline MnF_2. In region II, certain broad features are discussed of the purely magnetic one-magnon scattering of arbitrarily polarized neutrons by exchange-coupled lattices of the class alluded to previously and by more complex ones, studying this scattering in detail for ferromagnets and certain antiferromagnets. A new spin-wave effect is pointed out for polarized neutrons incident on ferromagnets. Brief treatments of the magneto-vibrational scattering in regions I and II are also given.

539.2 : 538.2

16139 MEASUREMENTS ON THE VARIATION OF COERCIVE FIELD AS A FUNCTION OF THE ANGLE IN NICKEL FILMS CONDENSED IN VACUUM.

A.Van Itterbeek and A.Dupré.

J. Phys. Radium, Vol. 19, No. 2, 113-18 (Feb., 1958).

The coercive force of evaporated nickel and cobalt layers has been determined by means of magnetoresistance measurements. A description of the evaporation apparatus is given. The thickness of the layers is determined by an optical method. The coercive force as a function of the angle φ between the normal to the plane of the film and the direction of the magnetic field behaves approximately as $A + B/\sin\varphi$ for $\varphi > 10°$. The change of the coercive force as a function of temperature can be written as $H_c = A \exp(-B\sqrt{T})$ for $T < 100°K$.

539.2 : 538.2

16140 RELATIONS BETWEEN THE SWITCHING COEFFICIENT AND THE LIMITING FREQUENCY OF FERROMAGNETIC MATERIALS.

R.Boll.

Z. angew. Phys., Vol. 12, No. 8, 364-70 (Aug., 1960). In German.

The switching coefficient S_W is shown to be given by $S_W = c/\gamma$, where γ is the gyromagnetic ratio and c a constant depending on the domain structure and specimen shape. Comparison is made with observations on ferrites and alloys, including thin films.

E.P.Wohlfarth

539.2 : 538.2

16141 DOMAIN STRUCTURE IN YTTRIUM IRON GARNET.

A.W.Smith and G.W.Williams.

Canad. J. Phys., Vol. 38, No. 9, 1187-94 (Sept., 1960).

The magnetic domain structure in thin slices of yttrium iron garnet crystals has been studied by transmitted polarized light. The transmitted light exhibits Faraday rotation and magnetic birefringence, and both effects have been used to observe the domain structure. An example of structure in samples having a growth face on one side is presented for each of the (110) and (112) planes. The structure for the (110) face is similar to that for an ideal sample in this plane. The structure for the (112) face differs from an ideal sample due to a large strain anisotropy.

539.2 : 538.2 : 530.16

FERROMAGNETISM OF A GAS OF HARD SPHERE FERMIONS WITH SPIN ½. See Abstr. 14537

539.2 : 538.2 : 621.318.132

16142 WALKER MODES IN LARGE FERRITE SAMPLES.

B.A.Auld.

J. appl. Phys., Vol. 31, No. 9, 1642-7 (Sept., 1960).

The modes of resonance for a ferrite strip and a ferrite post resonator between conducting planes are found by taking appropriate combinations of uniform plane wave solutions. It is shown that magnetostatic resonances (Walker modes) may exist even when the resonator dimensions are arbitrarily large, provided the mode indices satisfy certain restrictions.

539.2 : 538.2

16143 ADIABATIC DEMAGNETIZATION AND SPECIFIC HEAT IN FERRIMAGNETS.

J.E.Kunzler, L.R.Walker and J.K.Galt.

Phys. Rev., Vol. 119, No. 5, 1609-14 (Sept. 1, 1960).

The specific heat of yttrium iron garnet was measured at 1.45°K as a function of magnetic field from zero to 18 kOe. It is found to drop about 30% over this field range as the field is increased. Adiabatic temperature changes, ΔT, were observed during magnetic cycles over various field intervals in the range from 3 to 18 kOe, and at various temperatures between 1 and 4°K. The experimental values of ΔT and the specific heat fit the predictions of spin-wave theory to within experimental error. The data is sufficiently extensive to provide a useful test of spin-wave theory as well as checks on the consistency of the data itself as between the two types of observations. Values of various parameters which characterize the thermal and magnetic properties of YFe garnet are determined from this investigation to have the following values: Landau–Lifshitz exchange constant $A = 4.3 \times 10^{-7}$ erg/cm; Debye temperature $\theta = 510°$K. The serious effect of magnetic impurities on investigations of this sort is pointed out.

539.2 : 538.2

16144 MAGNETIC SUSCEPTIBILITIES AND PHASE TRANSITIONS OF TWO ANTIFERROMAGNETIC MANGANESE SALTS.

H.M.Gijsman, N.J.Poulis and J.Van Den Handel.

Physica, Vol. 25, No. 10, 954-68 (Oct., 1959).

The susceptibilities of single crystals of $MnCl_2.4H_2O$ and $MnBr_2.4H_2O$ were measured from 1° to 300°K. Both crystals become antiferromagnetic in the liquid helium temperature region. Using the method of nuclear resonance absorption, different transitions between antiferromagnetic states could be observed. The results are compared with the molecular field calculations of Gorter and Van Peski-Tinbergen (see Abstr. 5209 of 1956). The experimental data are in reasonable agreement with the theoretical calculations.

539.2 : 538.2

16145 CLASSICAL THEORY OF SPIN CONFIGURATIONS IN THE CUBIC SPINEL. T.A.Kaplan.

Phys. Rev., Vol. 119, No. 5, 1460-70 (Sept. 1, 1960).

It is shown that the Yafet–Kittel triangular spin-configurations (Abstr. 7388 of 1952) in the cubic spinel do not minimize the classical Heisenberg exchange energy. Only nearest-neighbour A–B and B–B interactions, J_{AB} and J_{BB}, are included; one spin-magnitude S_A for the A sites, and one, S_B, for the B sites is assumed. A theory of the classical ground state more general than that of Yafet and Kittel is investigated. This consists of first determining the largest value, y_0, of $y \equiv J_{BB}S_B/J_{AB}S_A$ for which the Neel configuration is stable with respect to arbitrary small spin-deviations. y_0 is roughly 10% smaller than the value of y found by Yafet and Kittel for the breakdown of the Neel configuration. A perturbation method for finding the minimum energy configuration when y-y_0 is small and positive is then employed. It is concluded: (a) that equilibrium configurations exist which have nonzero angles between spins on the A sites simultaneously with angles between those on the B sites, in contrast with the Yafet–Kittel results; and (b) that there will be long-range-ordered, canted spin configurations in the cubic spinel, contrary to Anderson's suggestion (Abstr. 5207 of 1956). These conclusions are discussed in connection with experiments on $MnCr_2O_4$ and Mn_3O_4.

539.2 : 538.2

16146 MAGNETIC PROPERTIES OF Mn_3O_4 AND THE CANTED SPIN PROBLEM. K.Dwight and N.Menyuk.

Phys. Rev., Vol. 119, No. 5, 1470-9 (Sept. 1, 1960).

The magnetic properties of single crystals of hausmannite (Mn_3O_4) were investigated between 4.2°K and the ferrimagnetic Curie point at 41.9°K. The c-axis was found to be the hard direction of magnetization and the c-plane was found to possess considerable anisotropy, with respective anisotropy fields of about 10^5 and 10^4 Oe. These anisotropy energies decreased slowly with increasing temperature, whereas the coercive force at 15°K was about an order of magnitude less than at 4.2°K. The spontaneous magnetization is 1.85 μ_B/molecule, which agrees with previous polycrystalline values when the observed anisotropies are taken into account. However, several of the observed properties of hausmannite disagree, some quantitatively and others qualitatively, with calculations based on the Yafet–Kittel theory. It is concluded that the concept of canted spins is essentially correct, but that the specific Yafet–Kittel model involves oversimplifications which limit its applicability.

539.2 : 538.

16147 CRYSTALLOGRAPHY AND DOMAIN WALLS IN ANTIFERROMAGNETIC NiO CRYSTALS. G.A.Slack.

J. appl. Phys., Vol. 31, No. 9, 1571-82 (Sept., 1960).

Twin-domain walls in large crystals of antiferromagnetic NiO have been observed by specular reflection in optically polished and annealed crystals. These walls can be moved in annealed crystals by small mechanical stresses ($< 10^6$ d/cm^2) or by moderate magnet fields ($<$ 25 000 Oe) to yield completely untwinned crystals. The ea with which a twin wall moves appears to be limited by a spin-rotati energy loss. Crystallographic measurements of the rhombohedral distortion agree with the X-ray data, and verify the [111] antiferromagnetic contraction. The anisotropy in the magnetic susceptibility versus field has been measured for untwinned crystals, and is compared with earlier work.

539.2 : 538.

16148 NEUTRON-DIFFRACTION STUDY OF Ti_2O_3. G.Shirane, S.J.Pickart and R.Newnham.

J. Phys. Chem. Solids, Vol. 13, No. 1-2, 166-8 (May, 1960).

Data were obtained at 295°K and 4.2°K with no observable difference. The results show that either Ti_2O_3 shows no antiferromagnetic ordering or that the magnetic moment is much reduced ($\leq 0.3\ \mu_B$). The results are compatible with the theory of Goodenou (see Abstr. 11554 of 1960). D.J.Oliver

Magnetic Resonances

539.2 : 538.27

16149 ON THE PHYSICAL SIGNIFICANCE OF KITTEL'S FORMULA IN FERROMAGNETIC RESONANCE. R.Vautie

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3801-3 (June 8, 1960). In French.

Discusses the exact role of the demagnetizing fields in affecting the resonance conditions. D.M.Edwards

539.2 : 538.27

16150 ON THE THEORY OF THE FERROMAGNETIC RESONANCE OF THIN FILMS. D.Fraitová.

Czech. J. Phys., Vol. 10, No. 1, 74 (1960).

The resonance conditions for ferromagnetic iron films with the (100) planes parallel to the film surface are derived, using an extension of the Neel concept of magnetic sub-lattices in a similar way to Dreyfus (Abstr. 1350-1 of 1956). The conditions are obtained as the roots of the secular determinant of the n-th degree formed from the general Bloch equation for a system of n atomic planes, and neglecting crystalline anisotropy and demagnetizing field. S.A.Ahern

539.2 : 538.27

16151 GENERATION OF PHONONS IN HIGH-POWER FERROMAGNETIC RESONANCE EXPERIMENTS.

E.Schlömann.

J. appl. Phys., Vol. 31, No. 9, 1647-56 (Sept., 1960).

The magnetoelastic energy of ferromagnets leads to a coupling between spin waves and elastic vibrations. Because of this coupling, the normal modes are not purely magnetic or purely elastic but contain admixtures of both kinds of excitation, the mixing being strongest when the unperturbed waves have the same frequency and wavelength. It is shown theoretically that, under suitable conditions (of frequency, d.c. field, and sample shape), coupled magnetoelastic waves with wavelengths of the order of 1 μ or less can be generated in high-power ferromagnetic resonance experiments. The magnetoelastic interaction increases the threshold precession angle of the uniform mode, the fractional increase being proportional to the grou velocity times the relaxation time for spin waves divided by the sam quantity for transverse phonons.

539.2 : 538.27

16152 ANISOTROPIC FERROMAGNETIC RESONANCE LINEWIDTH IN FERRITES. H.B.Callen and E.Pittelli.

Phys. Rev., Vol. 119, No. 5, 1523-31 (Sept.1, 1960).

In disordered magnetic materials such as the ferrites, the dominant source of resonance linewidth can be attributed to processes involving only two elementary excitations: the destruction of a magnon with the creation either of another magnon or a phonon. Here only the primary magnon–magnon scattering process is considered; it is shown that the random variation of the spin–orbit oling parameters of the disordered ions leads to a resonance width comparable to that observed in ferrites. The particular metry of the crystalline fields around the octahedrally coordi-d sites causes an anisotropy in the linewidth with a minimum he [100] directions and a maximum in the [111] directions. s anisotropy of linewidth is in general agreement with expe-ental observations on typical ferrites, as for example, the asurements of Schnitzler, Folen, and Rado on disordered lithium ite.

539.2 : 538.27

16153 THEORY OF MAGNETIC RESONANCE IN αFe_2O_3.

P.Pincus.

s. Rev. Letters, Vol. 5, No. 1, 13-15 (July 1, 1960).

The weak ferromagnetism exhibited by α-Fe_2O_3 above -14°C be explained by an anisotropic exchange interaction of the form $\vec{S}_1\times\vec{S}_2$ [Abstr. 8286 (1959)]. The author shows how the same eraction can explain the microwave results of Anderson et al. str. 4709 of 1954). D.J.Oliver

539.2 : 538.27

16154 MAGNETOSTATIC MODES IN DISKS AND RODS.

J.F.Dillon, Jr.

ppl. Phys., Vol. 31, No. 9, 1605-14 (Sept., 1960).

Ferrimagnetic-resonance experiments have been performed ng disk- and rod-shaped samples cut from single crystals of a nganese ferrite and of yttrium iron garnet. A multiplicity of ab-ption maxima were observed which can be identified as gnetostatic modes. The excitation of different sets of modes by magnetic field configurations of varying symmetries aids in signing indices to the modes observed. By far the narrowest es were observed in thin disks with the steady field normal to the ne of the disk.

539.2 : 538.27

16155 FERRIMAGNETIC RESONANCE IN THREE-SUBLATTICE SYSTEMS. R.K.Wangsness.

ys. Rev., Vol. 119, No. 5, 1496-500 (Sept. 1, 1960).

Two classes of three-sublattice systems are considered: anti-rallel and triangular. The general solution of the undamped equa-ns of motion is obtained and approximated to the highest order of molecular field coefficients of interest for each case. For the tiparallel case, the components of the susceptibility tensor are tained up to the first correction term to the usual expressions. r the triangular case, the leading terms needed for the suscepti-lity tensor are obtained and the effective gyromagnetic ratio aluated; the latter is quite different from the form usually assumed. new effect is also predicted for the triangular case when all sub-ttice gyromagnetic ratios are different; this effect consists of the oduction of an oscillating magnetization component perpendicular the oscillating field and of the same frequency and is not a conse-ence of nonlinear terms in the equations of motion.

539.2 : 538.27

16156 ON THE TEMPERATURE DEPENDENCE OF THE SHAPE OF PARAMAGNETIC RESONANCE LINES.

McMillan and W.Opechowski.

nad. J. Phys., Vol. 38, No. 9, 1168-86 (Sept., 1960).

A theory of the temperature dependence of the shape of para-agnetic resonance lines is developed for temperatures sufficiently w to make the effects of the spin—lattice interaction and thermal pansion negligible. General expressions for the first and second oments of the line shape function as functions of the temperature e obtained, and the approximations used are discussed in detail. ese expressions are applied to the case of effective spin $S = \frac{1}{2}$ and As an illustration of the general theory numerical results are ven for the paramagnetic resonance lines of nickel fluosilicate. this case the moments become strongly temperature dependent low 10°K.

539.2 : 538.27

16157 EFFECT OF CRYSTAL DEFECTS ON THE SPIN—LATTICE RELAXATION. B.I.Kochelaev.

kl. Akad. Nauk SSSR, Vol. 131, No. 5, 1053-6 (April 11, 1960). Russian.

Contrary to the accepted theory of spin—lattice relaxation, in ich the relative shifts of adjacent atoms are calculated assuming at the crystal is ideal and that its vibrations are described by bye waves, the effect of crystal defects is calculated, using the eory of vibrations of non-ideal lattices, proposed by Lifshits (Zh. sper. teor. Fiz., Vol. 17, No. 12, 1017, 1947 and Abstr. 3575 of 49). The formula obtained differs from the conventional one in that (1) the probability of transition depends on the distance between the paramagnetic atom and the defect, and (2) at $\hbar\omega \ll kT$ the dependence on the frequency of "spin quantum" disappears. F.Lachman

539.2 : 538.27

16158 THE THEORY OF SPIN—LATTICE RELAXATION OF PARAMAGNETIC IONS IN XY_6 COMPLEXES.

B.I.Kochelaev.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1423-7 (July, 1960). In Russian.

It is pointed out that some of the assumptions made in the theory of Van Vleck (Abstr. 1661 of 1940) are not valid for octa-hedral complexes in interaction and the Debye description of thermal motion is inadequate. A revised theory is presented briefly and the ratio of the chromium ion relaxation times in chrome alum and correndum at various temperatures is estimated. Better agree-ment with experiment is claimed than for Van Vleck's formulae. J.G.Powles

539.2 : 538.27

16159 CHARRED DEXTROSE AS A PARAMAGNETIC RESONANCE STANDARD. R.H.Hoskins and R.C.Pastor.

J. appl. Phys., Vol. 31, No. 8, 1506-7 (Aug., 1960).

It is suggested that charred dextrose is a more satisfactory field marker than DPPH because there is no variation of line width (0.6 oersted), g value or spin density between 1.4 and 500°K. Also T_1 is constant between 4.2 and 300°K. The material is easily prepared and is stable provided it is kept in a sealed container. J.M.Baker

539.2 : 538.27

16160 SPIN RELAXATION OF F-CENTER ELECTRONS.

W.E.Blumberg.

Phys. Rev., Vol. 119, No. 6, 1842-50 (Sept. 15, 1960).

Several possible mechanisms leading to spin transitions in the electron—nuclear spin system of an F-centre electron and its neigh-bouring nuclei have been examined. Calculations show that the most probable transition is one in which the electron spin changes, but the nuclear spin does not change, and which results from the second-order perturbation of the spin—orbit coupling of the electron due to lattice vibrations. The spin—lattice relaxation time of the F-centre electron in NaCl at 300°K was measured at 70, 2950, and 8300 G. The relaxation time is 2 μsec, independent of the magnetic field, in approximate agreement with the theory.

539.2 : 538.27

16161 MEASUREMENT OF F-CENTER CONCENTRATION AND RELAXATION TIME BY MICROWAVE FARADAY ROTATION. D.T.Teaney, W E.Blumberg and A.M.Portis.

Phys. Rev., Vol. 119, No. 6, 1851-3 (Sept. 15, 1960).

The use of a bimodal cavity for the observation of electron spin resonance is described. The two samples of NaCl containing F-centres used by Blumberg (see preceding abstract) were investigated by electron spin resonance. Their F-centre concentrations were found to be 4.4×10^{17} and 2.3×10^{18} electrons/cm^3, respectively. The spin—lattice relaxation time at room temperature of the F-centre electrons was found to be 1.7μsec.

539.2 : 538.27

16162 SPIN RESONANCE OF FREE ELECTRONS.

H.G.Dehmelt.

J. Phys. Radium, Vol. 19, No. 11, 866-71 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A new experimental technique for the detection of spin resonance of free thermal electrons and the measurement of the spin magnetic moment with appreciable precision is described. The electrons receive their orientation by a first exchange collision with an orien-ted alkali atom, are then reoriented by spin resonance and in a second exchange collision pass this reorientation on to the atoms whose orientation is monitored by the optical transmission tech-nique, oriented atoms absorbing less resonance light that unoriented ones. Equations describing the atom-free electron orientation interdependence and an equivalent r.c. circuit are developed which allow the evaluation of the spin exchange cross-section, Q, from the experimental signal intensities. For sodium, the lower limit $Q \geq 2.3 \times 10^{-14}$ cm^2 is evaluated. This is in agreement with the theoretical upper limit $\bar{Q} = 2.3 \times 10^{-14}$ cm^2. For certain limiting cases the exchange cross-section is shown to drop rapidly with increasing electron energy, E, first as $\sim E^{-1}$ and then even more rapidly when E approaches the singlet—triplet splitting of bound levels of the negative alkali ion which are assumed to exist close to zero binding energy. This energy dependence determines the choice of experimental methods to generate the free electrons.

Workable generation methods are discussed and new experimental results obtained employing photoionization of the alkali atoms are presented. The experimental apparatus is briefly described and an earlier obtained measurement of the sodium ground state free electron spin g-factor ratio

$$g_J\,(\mathrm{Na})/g_S = 1.000026 \pm 0.00003$$

is cited. Analogous experiments in which another species of alkali atoms takes the place of the free electrons are briefly reported.

539.2 : 538.27

16163 ELECTRON SPIN RESONANCE IN BISMUTH AND ANTIMONY. G.E.Smith, J.K.Galt and F.R.Merritt.

Phys. Rev. Letters, Vol. 4, No. 6, 276-8 (March 15, 1960).

The absorption peaks are interpreted in terms of Cohen and Blount's theory (Abstr. 16122 of 1960). In Bi, with the magnetic field along a dyad axis, it is concluded that the spin splitting of the Landau levels is less than the Landau spacing. The observed g-factor is about −200 for the low mass electrons. In Sb, with the magnetic field, along a bisectrix axis, it is concluded that the spin splitting is equal to the Landau spacing. The g-factor is 23.

D.M.Edwards

539.2 : 538.27

16164 PARAMAGNETIC RESONANCE OF Co^{2+} WITH FOUR- AND EIGHTFOLD COORDINATION.

T.P.P.Hall and W.Hayes.

J. chem. Phys., Vol. 32, No. 6, 1871-2 (June, 1960).

Measurements were made on cobalt present in 0.05% M concentration in CaF_2 and CdF_2 (eightfold coordination) and CdTe (fourfold coordination). The g-values were close to 2.3 and the hyperfine structure parameter A was about 23×10^{-4} cm^{-1}. These values are shown to be in reasonable agreement with theoretical expectations.

J.M.Baker

539.2 : 538.27

16165 CROSS RELAXATION EFFECT OF CHROMIUM AND IRON IN $K_3(Co,Cr,Fe)(CN)_6$. J.M.Minkowski.

Phys. Rev., Vol. 119, No. 5, 1577-8 (Sept. 1, 1960).

Strong coupling between spins of Cr^{3+} and Fe^{3+} and large ratio of spin–lattice relaxation times of these two ions at 4.2°K are demonstrated by inversion of ν_{14} transition of Cr^{3+}, when ν_{13} and ν_{24} transitions are saturated. At 1.9°K the spin–lattice relaxation times are nearly equal and no inversion takes place.

539.2 : 538.27

16166 DYNAMICAL PROPERTIES OF s–d INTERACTION. H.Hasegawa.

Progr. theor. Phys., Vol. 21, No. 4, 483-500 (April, 1959).

The dynamical properties of two spin systems composed of conduction electron spins and localized d-spins interacting by exchange are investigated in connection with the electron spin resonance of d-spins with the free electron g-value. It is concluded that some basic considerations are necessary for the problem along the line of the widely accepted idea that the s–d interaction itself does not lead to any relaxation time and shift. The usual adiabatic approximation is applied to this idea. A modified damping equation of the Bloch type as well as Bloch's relaxation theory are also useful, but these are not enough for a complete solution of the problem. A certain controversy involved in recent experimental and theoretical work at Berkeley concerning the electron spin resonance in Cu–Mn dilute alloy is pointed out and examined. It is believed that the possibility cannot be eliminated that the spin–lattice relaxation time of conduction electrons in the alloy due to mechanisms other than the s–d interaction is longer than previous authors have assumed.

539.2 : 538.27

16167 THE APPLICATION OF DENSITY MATRIX TECHNIQUES TO SOME PROBLEMS OF DOUBLE RESONANCE.

W.E.Lamb and L.Wilcox.

J. Phys. Radium, Vol. 19, No. 11, 801 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). In recent studies of the microwave fine structure of the n = 3 states of atomic hydrogen it was necessary to solve the wave equation for a system of three or more decaying levels which were simultaneously perturbed by radiofrequency and static electric field. In the rotating wave approximation the problem is equivalent to one involving simultaneous irradiation with any two radiofrequencies. The calculation of resonance line shape and shifts becomes much simpler when, instead of the usual time-dependent perturbation theory, use is ma of the density matrix formulation, suitably generalized to allow fo the excitation and decay of the states. For the case of two levels equations can be written in a form very similar to those of the phenomenological theory of nuclear induction, and a very simple derivation of the Bloch–Siegert shift may be obtained. (This abstract is all that appears, there is no text to the article).

539.2 : 538.

16168 PARAMAGNETIC RESONANCE OF GAMMA-IRRADIA SINGLE CRYSTALS OF ICE AT 77°K.

J.A.McMillan, M.S.Matheson and B.Smaller.

J. chem. Phys., Vol. 33, No. 2, 609-10 (Aug., 1960).

The spectra observed showed sixfold rotational symmetry abo the c-axis of the crystal. The results can be accounted for on the basis of a cylindrically symmetric radical: (1) having an unpaire electron interacting with a proton at approximately 1 A distance; (2) having its symmetry axis pointing towards any of the corners the hexagon (0001); (3) having equal populations in each of these orientations. The measured values of the parameters of the spin Hamiltonian are given. The authors believe that the strong dipola field of the water molecules breaks down the Russell–Saunders coupling leading to spin-only paramagnetism.

J.M.Bak

539.2 : 538.

16169 PARAMAGNETIC RESONANCE AND OPTICAL SPECTRUM OF IRON IN BERYL. M.Dvir and W.Low

Phys. Rev., Vol. 119, No. 5, 1587-91 (Sept. 1, 1960).

The paramagnetic resonance spectrum of Fe^{3+} in beryl was measured at 20° and 290°K. In addition to this spectrum many we lines were observed and possible explanations of these lines are discussed. The optical spectrum shows a spectrum characteristi of trivalent iron. In the infrared region there are several groups of sharp lines whose origin is not yet known.

539.2 : 538.

16170 DIRECT MEASUREMENT OF THE ELECTRON DENSITY AT THE NUCLEUS IN METALLIC LITHIUM AT LIQUID HELIUM TEMPERATURE. C.Ryter.

Phys. Rev. Letters, Vol. 5, No. 1, 10-11 (July 1, 1960).

When the e.s.r. in a metal is partially saturated, the nuclear polarization is greatly increased. A shift in the e.s.r. line occurs which is related to the nuclear magnetization. Measurements of this shift were performed at 9340 Mc/s, between 4.2 and 1.5°K, with microwave powers up to 30 mW, in single crystals of lithium fluoride containing particles of metallic lithium produced by neutron irradiation and subsequent heat treatment. The nuclear relaxation times were long and were also measured as a function of temperature.

J.M.Bak

539.2 : 538

16171 MAGNETIC RESONANCE AND RAPID PASSAGE IN IRRADIATED LiF. J.S.Hyde.

Phys. Rev., Vol. 119, No. 5, 1483-92 (Sept. 1, 1960).

The experimental result of Portis (Abstr. 1384 of 1956) that room temperature the paramagnetic dispersion signal ($d\chi_m'/dH$) radiation-induced paramagnetic centres in LiF has the shape of a undifferentiated Gaussian curve and lags the modulation field by 90 deg has been confirmed. His theory, explaining this result as manifestation of rapid-passage behaviour, has been tested over a range of experimental parameters and appears valid. In terms of this theory the author found that the spin–lattice relaxation time T_1 was 1.5×10^{-4} sec at room temperature. The prediction has b made by Portis that, if $\omega_m T_1 \gg 1$, where ω_m is the modulation fre quency, the rapid-passage signal should lag the modulation field b 180 deg. A lag of 130 deg has been found at 4°K in LiF, using a mo lation frequency of 23 c/s, and the phase appears to approach a constant value. The same phase shift (130°) can be found at room temperature by using 400 c/s modulation and can be interpreted a indicating that $T_1 = 2.6 \times 10^{-3}$ sec at 4°K. It seems more likely, however, that at 4°K the assumption made by Portis that $T_2 \gg T_1$ fails, and that spin–spin effects make the situation more complex An argument is presented that the magnetic resonance arises fro the F centre. From its shape a value for the hyperfine splitting $h_\gamma = 32 \pm 1$ gauss was obtained. This result is compared with tho of other workers who have reported resolved structure in LiF, an the conclusion is reached that the resolved structure resonances probably do not arise from the F-centre.

539.2 : 538.27

16172 SATURATION OF THE MAGNETIC RESONANCE ABSORPTION IN DILUTE INHOMOGENEOUSLY ROADENED SYSTEMS. J.S.Hyde.
ys. Rev., Vol. 119, No. 5, 1492-5 (Sept. 1, 1960).

The existing theory due to Portis (Abstr. 1863 of 1954) for the uration of inhomogeneously broadened resonances is discussed and ew theoretical formulation of the problem is developed using an ression for the transition probability first given by Rabi. For greater than both T_1^{-1} and T_2^{-1}, the r.f. field interacts with spins cessing in the frequency interval γH_1; this expression permits licit calculation of the resulting magnetic loss. No assumption made of the shape of the individual (homogeneously broadened) n packets in weak exciting fields. For F-centres in alkali halides, results are identical with those of Portis, but the underlying sical reasons differ.

539.2 : 538.27

16173 MEASUREMENTS BY ELECTRONIC AND NUCLEAR DOUBLE RESONANCE ON THE HYPERFINE STRUCT- RE IN SOLIDS. B.Bleaney.
Phys. Radium, Vol. 19, No. 11, 826-9 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A neral discussion is given of the advantages of the ENDOR technique measuring hyperfine structure in paramagnetic salts, together th some of the anomalies which may be encountered. A brief count is given of the measurements of Halford, Hutchison and ewellyn (Abstr. 7323 of 1958) on the Nd^{3+} ion in $LaCl_3$ crystals by s method.

539.2 : 538.27 : 537.311

16174 APPLICATIONS OF THE TECHNIQUE OF ELECTRONIC AND NUCLEAR DOUBLE RESONANCE (ENDOR) TO ONORS IN SILICON. G.Feher.
Phys. Radium, Vol. 19, No. 11, 830-3 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). The uble resonance technique was applied to P, Sb, and As doped sili- on. The method enables one to determine the h.f. interaction of e donor electron with the Si^{29} nuclei at different lattice points. oth the isotropic and anisotropic hyperfine interactions were deter- ined. By comparing the experimental results with the theoretical ave-function of Kohn and Luttinger (Abstr. 4660, 6337 of 1955) one tains, for the value of the conduction band minimum in silicon, $/k_{max} = 0.85 \pm 0.03$. Some general aspects of inhomogeneously oadened lines are discussed.

539.2 : 538.27

16175 GREEN AND PURPLE SULFUR: ELECTRON-SPIN RESONANCE STUDIES. H.E.Radford and F.O.Rice.
chem. Phys., Vol. 33, No. 3, 774-6 (Sept., 1960).

Electron spin resonance absorption was found in the coloured eposits formed by condensing heated sulphur vapour on cold surfaces. omplexities in the resonance spectrum give evidence for the xistence in the cold deposits of at least two types of trapped sulphur adicals with differing degrees of internal magnetic anisotropy. easurements of the intensity and stability of the resonance absorp- on yield information on the radical trapping process.

539.2 : 538.27 : 539.214

16176 PARAMAGNETIC-RESONANCE STUDIES OF IRRADIATED HIGH-DENSITY POLYETHYLENE. I. RADICAL PECIES AND THE EFFECT OF ENVIRONMENT ON THEIR EHAVIOR. E.J.Lawton, J.S.Balwit and R.S.Powell.
. chem. Phys., Vol. 33, No. 2, 395-404 (Aug., 1960).

Linear polyethylene (Marlex-50) was irradiated at different emperatures with 800 kV (peak) electrons. It was examined for aramagnetic resonance at +25° and −196°C to determine the radical pecies and their post-irradiation behaviour as well as that of the rystalline trapping medium. At low doses the spectrum is composed f two radical species which decay at different rates at room tempera- ure. The predominant radical decays to zero in about five days; ts six-line hyperfine structure is attributed to $-CH_2-\overset{\circ}{C}H-CH_2-$. he fast decay supports a previous suggestion that the polymer adicals are formed in pairs on adjacent chains. The other radical as a basic five-line spectrum with additional "very fine" structure. lasts for months at room temperature. The behaviour of the "very ine" structure on cooling to liquid-nitrogen (LN) temperature and he initial low concentration of the radical suggest its probable tructure to be $-CH_2^{*}-H_2C\cdot\,:\,\cdot CH_2-CH_2-$. The relative numbers of ach radical trapped at room temperature depend on the rigidity of he crystal, and therefore, on temperature during irradiation. The six-line radical pairs exist as several groups decaying at different rates at room temperature. The half-life of the fastest decaying group was 10 sec, that of the slowest, 25 hr. The fastest group comprises pairs in which the two radicals are formed nearly opposite each other on adjacent chains. They cause spin—spin line broadening in the time-zero LN spectrum. The decay rate of the radical pair is determined by the rigidity of the crystal. An apparent transition point for the crystal exists at −70°C, below which there is only a slight decay of the closest-spaced radicals. The total number of radicals produced and trapped by 40 megaroentgens at LN temperature was 6.2×10^{19}/g which corresponded to a G (total radicals) =3.0.

539.2 : 538.27 : 539.214

16177 PARAMAGNETIC-RESONANCE STUDIES OF IRRADAITED HIGH-DENSITY POLYETHYLENE.
II. EFFECT OF IRRADIATION DOSE ON THE RADICAL SPECIES TRAPPED AT ROOM TEMPERATURE.
E.J.Lawton, J.S.Balwit and R.S.Powell.
J. chem. Phys., Vol. 33, No. 2, 405-12 (Aug., 1960).

The results of Pt I on low dose levels are extended to a level of 4000 megaroentgens. The kind and relative number of each radical trapped at room temperature (RT) depends on the degree and tightness of the crystalline and crosslinked fractions during irradiation. At least two of three distinct species, having different hyperfine structures (six-, five-, and a single-line) are present in varying concentrations at all doses. The six- and five-line radicals are trapped in the crystal, whereas the single-line radical is trapped in the highly crosslinked medium. During irradiation at RT and liquid-nitrogen (LN) temperature, the crystal is not as effective in trapping the six-line radical as in the absence of irradiation. At 640 megaroentgens the six-line radical does not survive during irradiation at RT, leaving the five- and single-line radicals above this level. The single-line radical appears at 320 megaroentgens and increases until at 3000 megaroentgens, where crystallinity is zero, it accounts for about 70% of the total. Heating the irradicated samples causes all radicals to disappear; the "extinction temperatures" for the six-, five-, and single-line radicals were 90°, 135°, and about 250°C, respectively. The relative effectiveness of the preirradiated annealed samples compared to the nonirradiated Marlex-50 in trapping radicals at RT was 0.5 for the 20 megaroentgen, 1.0 for the 320 megaroentgen, and 1.4 for the 4000 megaroentgen preirradiated material. There is evidence in the u.v. spectrum for conjugated double bonds in the highly irradiated samples. It is proposed that the single-line radical is initially formed adjacent to the conjugated sequence and then becomes trapped within the sequence by resonance. The radical could be represented as

$$-CH{=}CH-CH{=}CH-\overset{\leftarrow\,\cdot\,\rightarrow}{CH}-CH{=}CH-CH{=}CH-.$$

... : 38.27

161678 A NOTE ON THE PARAMAGNETIC RESONANCE OF FREE RADICAL. P.Swarup and B.N.Misra.
Z.Phys., Vol. 159, No. 4, 384-7 (1960).

Paramagnetic resonance in diphenyl-picryl-hydrazyl was studied and the results are compared with those of other workers. Low-temperature work indicated that the transition from paramagnetic to antiferromagnetic state should occur at 1°K.

539.2 : 538.27

16179 PARAMAGNETIC RESONANCE ALONG THE DIRECTION OF THE POLARIZING FIELD.
P.Jung, J.Van Cakenberghe and J.Uebersfeld.
Physica, Vol. 26, No. 1, 52-60 (Jan., 1960).

An r.f. susceptibility along the polarizing field is observed when the electron spin resonance of DPPH is partly saturated at microwave frequency. The variation of the real and imaginary parts as a function of the r.f. were studied. Theoretical calculations are in good agreement with experiment. In some cases a negative susceptibility appears, which has been used in a molecular amplifier experiment.

539.2 : 538.27 : 539.14

PARAMAGNETIC RESONANCE OF Ni AND Co IN MgO: NUCLEAR MOMENT OF Ni^{61}. See Abstr. 15513

539.2 : 538.27 : 621.375.9

16180 CHROMIUM-DOPED TITANIA AS A MASER MATERIAL. H.J.Gerritsen, S.E.Harrison and H.R.Lewis.
J. appl. Phys., Vol. 31, No. 9, 1566-71 (Sept., 1960).

A discussion of the paramagnetic properties of Cr^{3+} in TiO_2 is given with particular reference to its use in solid-state masers. Energy level diagrams are included for magnetic fields in the (110), ($1\bar{1}0$), (001), and (100) planes.

539.2 : 538.27

16181 SEVERAL-QUANTA TRANSITIONS AND MASER AMPLIFICATION IN TWO-LEVEL SYSTEMS. A.Javan.

J. Phys. Radium, Vol. 19, No. 11, 806-8 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Any quantum mechanical system which permits a radiative transition between two energy levels will allow a multiple quanta transition, if, in addition, at least one of the energy levels shows a finite average of the electrical or magnetic dipole moment. This effect can be used for producing a net induced emission of microwave power in systems with a normal (positive temperature) distribution of population. The process is similar to a coherent Raman scattering phenomenon where two quanta are involved in a transition, with one of the photons being absorbed while the other is emitted. Stimulated emission at a frequency ω can thus be obtained from a two level system with energy separation $\hbar\omega_0$, when an additional radiation field is present at a frequency $\omega' = \omega_0 + \omega$, ω' being larger than ω_0. If the applied power at the frequency ω' is distributed over a frequency interval larger than the width of each level, the shape of the emission resonance will be determined by this frequency distribution. The specific case of a spin 1/2 system is treated to obtain the susceptibility at the amplified frequency and the noise figure originating from spontaneous emission. Application to maser action in ferrites, molecules and other physical systems is discussed. The effect can also be used for the purposes of spectroscopy and detailed study of the line shape of an optical and microwave photons are involved.

539.2 : 538.27

16182 THE POSSIBILITY OF OBSERVING COOPERATIVE PHENOMENA IN NUCLEAR MAGNETISM.

A.Abragam.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 225-7 (July 11, 1960). In French.

Temperatures of approximately 10^{-7} °K must be realized and these can be obtained by adiabatic demagnetization from an initial temperature of 10^{-2} °K or 10^{-3} °K. The low initial temperatures can be obtained by a dynamic nuclear polarization using for example the Overhauser effect. Some of the interesting features of the type of experiment are described. D.J.Oliver

539.2 : 538.27

16183 THE INCREASE OF NUCLEAR SIGNALS BY DYNAMIC POLARIZATION. I. I.Solomon.

J. Phys. Radium, Vol. 19, No. 11, 837-9 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Two systems of interacting spins I and S were considered and three cases studied experimentally: (1) Interaction between conduction electrons (system S) with nuclei (system I) in a semi-conductor (silicon). Saturation of the electronic line gave a large increase of the nuclear signal. (2) Interaction of protons in water with paramagnetic ions of a free radical having a hyperfine structure. The enhancement of the proton signal was large enough to obtain a maser action. (3) Interaction of two systems of spins in a solid. Irradiation at the sum or difference of resonance frequencies gave an enhancement of the signal of one of the spin systems.

539.2 : 538.27

16184 THE INCREASE OF NUCLEAR RESONANCE SIGNALS BY DYNAMIC POLARIZATION. II. J.Combrisson.

J. Phys. Radium, Vol. 19, No. 11, 840-2 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). The enhancement of nuclear polarization obtained by saturating the resonance of electronic spins in interaction with nuclear spins makes possible the observation of considerably increased nuclear signals and, in some cases, maser action is obtained. Dipole—dipole and scalar type interaction have been studied. Experimental results obtained in a low field (70 G) and a high field (3000 G) are given.

539.2 : 538.27

16185 HYPERFINE INTERACTION AND THE KNIGHT SHIFT. F.J.Milford.

Amer. J. Phys., Vol. 28, No. 6, 521-7 (Sept., 1960).

The difference between the magnetic field at which a specific nuclear magnetic resonance occurs in a metal and the field at which the same resonance occurs in a nonmetallic compound is known as the Knight shift. The prediction of this shift is a straightforward and sensitive test of electronic wave functions in metals. An elementary derivation of the relationship between the Knight shift and the electronic wave functions is presented here. The current experimental and theoretical situation is briefly reviewed. Also included is a derivation of the S state magnetic hyperfine interaction Hamiltonian.

539.2 : 538.2

16186 ON THE KNIGHT SHIFT OF ALLOYS. A.Blandin, E.Daniel and J.Friedel.

Phil. Mag. (Eighth Ser.), Vol. 4, 180-2 (Feb., 1959).

The change and broadening of the Knight shift of silver produce by various solute elements are explained by the fluctuations in electronic density produced at long range by each solute atom. The cha in Knight shift observed for Cd, In, Sn and Sb solutes are in satisfactory agreement with those computed using a free electron approx mation for the matrix. From the sign and the values of the changes observed for Pd and Pt solutes, it is concluded that most of the screening arises there from an emptying of their d shells, especiall for Pt. Finally, the change and broadening of the Knight shift of the solute elements are explained in the same way.

539.2 : 538.2

16187 DOUBLE IRRADIATION EXPERIMENTS IN MAGNETIC RESONANCE BY THE IMPULSE METHOD.

D.E.Kaplan and E.L.Hahn.

J. Phys. Radium, Vol. 19, No. 11, 821-5 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Experiments are carried out where the free nuclear precession echoes of one spin system (A) is observed at a given frequency, while a different excitation frequency is applied to another species of nuclei (B) in the same sample. The (B) species is dipole—dipole coupled to the (A) species, and the resonance excitation of (B) is detected in terms of the change in relaxation times of the observed (A) species. Various mechanisms for induced (A)—(B) couplings are found.

539.2 : 538.2

16188 NUCLEAR DOUBLE RESONANCE IN LITHIUM FLUORIDE CRYSTALS. E.E.Schneider and K.Thompson.

J. Phys. Radium, Vol. 19, No. 11, 834-6 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A simple theory is given for the effects on the resonance of a nuclear species A, in a solid sample, of a simultaneous irradiation by a strong r.f. field at a frequency ω_B of another nuclear species B present in the sample in comparable abundance. This theory is applied to a single crystal of LiF. The experimental set up for double irradiation is described and results are given. The effect of irradiation of B on the line width of A is much smaller, and that on the spin lattice relaxation time T_1^A much larger, than predicted by the previous theory. For T_1^A a relationship is suggested between these experiments and those of Sorokin and Bloembergen on CsBr (Abstr. 4389 of 1958).

539.2 : 538.2

16189 THE EFFECT OF THE MOBILITY OF PROTONS ON THE WIDTH OF NUCLEAR MAGNETIC RESONANC LINES IN CRYSTALS. I.V.Aleksandrov, N.N.Korst and N.D.Sokolo

Optika i Spektrosk., Vol. 8, No. 4, 575-7 (April, 1960). In Russian.

The mobility of hydrogen atoms (protons) in condensed phases may be due to internal rotation or translational transitions from one equilibrium position to another. Nuclear magnetic resonance of protons is one of the most effective methods of investigating their mobility. It is shown theoretically that the second moment of the nuclear magnetic resonance signal of protons in ice can be used to find the mechanism of proton transitions. A.Tybulewic

539.2 : 538.2

16190 PROTON-MAGNETIC-RESONANCE STUDY OF BARIU BROMIDE MONOHYDRATE.

J.W.McGrath and A.A.Silvidi.

J. chem. Phys., Vol. 33, No. 3, 644-7 (Sept., 1960).

The proton magnetic resonance doublets were obtained for rotation of the crystal around its c axis. From these data, the proton—proton separation was computed to be 1.56 ± 0.02 A. The hydrated water molecule was found to lie in one orientation whose proton—proton axis makes direction angles of $\alpha_0 = 89 \pm 1^\circ$, $\beta_0 = 1 \pm 1^\circ$, and $\gamma_0 = 90 \pm 6^\circ$, measured from the positive a, b, and c crystallographic axes, respectively. This orientation fits well into the crystal structure and indicates that the complex, Br_I- -H—O—H- -Br_{II} exists. Linewidths range from 6.5 to 4.2 G and show a correlation with T_1 as a function of orientation. Observation was necessarily made with some saturation. A new effect,

ymmetry of line areas in the doublets, was observed for
w ranges near two crystal orientations. The two orientations
symmetrically close to that for which the proton—proton line
arallel to the external magnetic field. It may be due to cross-
, the barium quadrupole resonance frequencies over the
etic-resonance frequencies of the protons.

539.2 : 538.27

191 PROTON MAGNETIC RESONANCE STUDY OF HYDRATES BY SPINNING CRYSTALS.
dambaram.
Cimento, Vol. 17, No. 1, 106-8 (July 1, 1960).
The specimen is rotated about an axis at a frequency ω and
nal observed with a phase sensitive detector locked to fre-
y 4ω. Calculation shows that a signal will only be observed
nuclear resonance is not symmetric about the axis of rota-
It is suggested that as a consequence hydrate protons can
udied separately in the presence of isolated protons or re-
ting ammonium ions which have in many cases approximately
ly symmetric resonances. D.J.Oliver

539.2 : 538.27

192 NUCLEAR MAGNETIC RESONANCE IN SOLID ADAMANTANE. D.W.McCall and D.C.Douglass.
em. Phys., Vol. 33, No. 3, 777-8 (Sept., 1960).
Proton magnetic resonance studies of solid adamantane reveal
xistence of a rotational transition at about −130° C. The
ation energy associated with the rotational transition is found
about 5 kcal/mole. Theoretical and experimental second
ents agree if it is assumed that the molecules are rigidly fixed
the transition and rotate freely above the transition.

539.2 : 538.27

6193 QUADRUPOLE RESONANCE SPECTRUM OF CHLORANIL AND ITS HEXAMETHYLBENZENE
PLEX. D.C.Douglass.
em. Phys., Vol. 32, No. 6, 1882-3 (June, 1960).
Pure chlorine quadrupole resonance of tetrachloroquinone and
1 complex with hexamethylbenzene is used to investigate the
c character of the chlorine—carbon bond. It is concluded that
charge transfer is small. No signal could be found in a number
elated complexes. J.G.Powles

MECHANICAL PROPERTIES OF SOLIDS

539.3

6194 GELATIN SOLUTION AS A MODEL AND PHOTOELASTIC MATERIAL. A.J.Carmichael and A.G.Douglas.
tral. J. appl. Sci., Vol. 11, No. 2, 272-88 (June, 1960).
Aqueous solutions of gelatin, when set, behave in a manner which
be described as "rubber-like". This material has good elastic
erties and remarkable optical sensitivity, which makes it an
l photoelastic material for representing body-force problems,
problems involving large elastic deformations. Important
hanical and optical properties of various gelatin mixes, and the
ct on including glycerin, are described. The behaviour of gelatin
orsion, tension, and compression, and the mechanical creep and
xation are considered. The variation of these properties with
e, temperature, and pH is discussed and sufficient information is
n to enable the confident construction of models. The birefrin-
e of gelatin solution has been known for some time, but very little
iled investigation of this phenomenon has been reported since
pioneer work of Farquharson and Hennes (1940). An accurate
bration of this material is outlined, together with a discussion
e variation of optical sensitivity with time and temperature.

539.3

6195 METHOD OF MEASURING THE COMPLEX SHEAR MODULUS IN FREQUENCY RANGE 1-100 kc/s.
echhold.
stica, Vol. 9, No. 1, 39-48 (1959). In German.
A cylindrical torsional resonator (1 to 100 kc/s) of small
ping, to which a test specimen is mechanically coupled, shows
ncrease in the damping of its resonance and a shift of its
ral frequency. From the values of these two effects the complex
ar modulus of the test specimen can be calculated. If the sub-
ce shows macroscopic creep it is put in a hollow cylinder; if it
is a firm plastic a small test cylinder is glued, screwed or pressed on to an end surface of the resonator. Examples are given of applications to paraffin and polyethylene as well as the hardening and temperature behaviour of an Araldite resin.

539.3 : 535.55

16196 DETERMINATION OF POISSON'S RATIO OF A DOUBLY-REFRACTING MATERIAL BY A PHOTO-ELASTIC METHOD. H.Bufler.
Z. angew. Phys., Vol. 12, No. 7, 334-5 (July, 1960). In German.

An optical method, based on the determination of the isochromatic line of zero order and requiring no loading equipment, is described for finding Poisson's ratio of Araldite ($1/m = 0.4$).

H.J.H.Starks

539.3 : 621.317.39

16197 MEASUREMENT OF CYCLIC STRAIN. T.M.Dowell and J.A.Mackinnon.
J. sci. Instrum., Vol. 37, No. 7, 255 (July, 1960).

Correction to circuit diagram in Abstr. 8101 of 1960.

539.3

16198 STRAIN COEFFICIENTS OF THIN LAYERS OF BISMUTH, TELLURIUM AND GERMANIUM.
A.F.Gorodetskii, G.N.Guk and B.I.Puchkin.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 47-55 (1959). In Russian.

Reports measurements of the strain coefficients of electrical-resistance strain gauges in the form of narrow bands of Bi, Te and Ge deposited in vacuo on glass or other substrates. These coefficients are defined as $S = \Delta R/R\epsilon$, where R is the initial resistance of a gauge and ΔR is the change of resistance produced by a relative deformation ϵ. The values of S were: 8-22 for Bi, 15-32 for Te and 35-56 for extension of Ge and up to 120 for compression of Ge. The Ge and Bi gauges did not deteriorate with time.

A.Tybulewicz

539.3

16199 ELASTIC CONSTANTS OF BISMUTH. Y.Eckstein, A.W.Lawson and D.H.Reneker.
J. appl. Phys., Vol. 31, No. 9, 1534-8 (Sept., 1960).

The six adiabatic elastic stiffness constants of bismuth have been determined at 301° K by anultrasonic pulse echo technique. The results are: $c_{11} = 63.5$, $c_{33} = 38.1$, $c_{44} = 11.30$, $c_{66} = 19.4$, $c_{14} = +7.23$, and $c_{13} = 24.5$, all in units of 10^{10} d/cm^2. These values were redundantly determined by the measurement of 14 different velocities in four different single crystals of zone-purified bismuth. The velocities are believed accurate to better than 1%, the principal error arising from the uncertainty of the transducer transit time correction. The moduli are in poor agreement with the previously determined static elastic compliance constants reported by Bridgman (Abstr. 681 of 1926). Some data on the velocity of sound in bismuth at 98° and at 4.2° K are also presented.

539.3

16200 ELASTIC MODULI OF VANADIUM. G.A.Alers.
Phys. Rev., Vol. 119, No. 5, 1532-5 (Sept. 1, 1960).

Using the technique of zone melting by electron bombardment, $\frac{3}{8}$ in. diameter single crystals of vanadium were grown in a high vacuum. Two crystals were prepared from seeds such that their lengths were parallel to the [100] and the [110] crystal directions. With these orientations, the elastic moduli C_{11}, C_{44}, and $\frac{1}{2}(C_{11} - C_{12})$ were measured directly from 4.2° K to 300° K using the ultrasonic pulse-echo technique. The results are, in units of 10^{11} dyne cm^{-2}, 22.795, 4.255, and 5.460 at 300° K, and 23.240, 4.595, and 5.652 at 4.2° K. The moduli at 4.2° K were used to calculate a Debye θ_0 of 399.3° K which disagrees with the θ_0 of 338° K obtained from calorimetry. The room temperature moduli agree very well with all other determinations. The moduli were used to calculate a phonon frequency distribution which is compared with the distribution measured by slow neutron scattering.

539.3

16201 EFFECTS OF TORSION ON THE TENSILE STRESS—STRAIN CURVE OF ALUMINIUM. D.B.Holt.
Acta metallurgica, Vol. 7, No. 7, 446-68 (July, 1959).

The work hardening of aluminium single crystals was investigated by alternate tensile and torsional deformation. The relative increase of tensile flow stress due to twisting was systematically investigated in relation to prior extension, crystal orientation and amount of twist. Crystallographic analysis of slip lines was carried out. This showed that several modes of torsional deformation occurred in different orientation regions. Some of these modes correspond to proposed dislocation mechanisms. Analysis of the azimuthal distributions of tensile slip lines on crystals which have been twisted and extended showed that dislocation barriers were formed in agreement with the Lomer—Cottrell theory of sessile dislocations. The relative increase of tensile flow stress and the change of hardening rate due to twisting are discussed in terms of dislocation theory.

539.3

16202 THE EFFECT OF QUENCHED-IN VACANCIES ON THE ELASTIC MODULUS OF ALUMINUM.

R.C.Folweiler and F.R.Brotzen.
Acta metallurgica, Vol. 7, No. 11, 716-21 (Nov., 1959).

Equipment for the dynamic measurement of modulus changes was developed. The presence of lattice vacancies was found to reduce the elastic modulus. The change in modulus was investigated during annealing at room temperature subsequent to quenching. The time relation of vacancy concentration observed was analogous to that determined by electrical resistivity measurements.

539.3

16203 VARIATION OF THE ELASTIC CONSTANTS OF QUARTZ FILAMENTS CAUSED BY Co^{60} γ-RAYS.

S.V.Starodubtsev, L.P.Khiznichenko and I.A.Domoryad.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 4, 803-5 (June 1, 1960).
In Russian.

Fused-quartz (silica) filaments (diam. 80 - 150μ) were tested by the torsional-oscillation method in a special apparatus (described in some detail), ensuring a high accuracy. It was found that a gamma-ray dose of 8×10^8 r increases the modulus of elasticity of fused quartz by 0.16 ± 0.02%, the error being due to the factors of geometrical deformation. F.Lachman

539.3

16204 TEMPERATURE DEPENDENCE OF THE ADIABATIC ELASTIC MODULI OF SINGLE-CRYSTAL ALPHA URANIUM.

H.J.McSkimin and E.S.Fisher.
J. appl. Phys., Vol. 31, No. 9, 1627-39 (Sept., 1960).

The ultrasonic-wave velocities in small alpha-uranium single crystals have been measured at various temperatures using the phase-comparison technique. Details in the experimental procedure, direct computation of the stiffness moduli, and cross-checking by indirect methods are given. The temperature dependence of the moduli are reported for the range -195^0 to $+300^0$C for c_{11}, c_{22}, and c_{33} and -195^0 to $+35^0$C for the remaining 6 principal moduli. The results show a very marked abnormal temperature dependence of the elasticity in the 100 direction; c_{11} decreases with temperature below -17.2^0C and the linear compressibility in 100 increases from $+35^0$ to -195^0C. The bulk modulus passes through a maximum at -100^0C. These abnormalities indicate a strong temperature dependence of the electron interactions involved in the second nearest neighbour bond.

539.3

16205 TEMPERATURE DEPENDENCE OF THE ELASTIC ANISOTROPY OF KI. L.A.Kalinets.

Kristallografiya, Vol. 3, No. 6, 759-61 (Nov.-Dec., 1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3, No. 6, 769-71 (Jan., 1960).

The elastic constants of KI crystals were obtained from frequency measurements made at temperatures over the range from room temperature to 550^0C. The results showed that, at room temperature, the elastic properties were markedly anisotropic and the constant of elastic anisotropy $k = 2s_{11} - 2s_{12} - s_{44}$ had a negative value. The value of k decreased as the temperature was raised, passed through zero near 650^0C and then became positive.
H.J.H.Starks

539.3

16206 MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS AT LOW TEMPERATURES. A COMPILATION FROM THE LITERATURE.

R.M.McClintock and H.P.Gibbons.
Nat. Bur. Stand Monogr. 13, 180 pp.(1960).

539.3

16207 BEHAVIOR OF THE PRINCIPAL ELASTIC MODULI AND SPECIFIC HEAT AT CONSTANT VOLUME OF KCl AT ELEVATED TEMPERATURES.

F.D.Enck.
Phys. Rev., Vol. 119, No. 6, 1873-7 (Sept. 15, 1960).

Measurements of the adiabatic elastic constants of KCl were made in the region 300^0K to the melting point (1043^0K) by a dynamical method developed by Balamuth (1934). Recently determined values of the specific heat at constant pressure (C_p) were used to calculate the isothermal values of the compressibility Values of the specific heat at constant volume (C_V) were obtaine using recent values of the coefficient of thermal linear expansio (α), the above mentioned values of C_p, and the isothermal compr ibilities. The results indicate that there is a slight rise in C_V al the Dulong—Petit value above 725^0K. This rise is not significan since the estimated error interval incloses the Dulong—Petit value, and consequently the D--P law is most likely valid up to tl melting point.

53

16208 ELASTIC BEHAVIOUR OF MATTER UNDER VERY HIGH PRESSURES. UNIFORM COMPRESSION.

S.Bhagavantam and E.V.Chelam.
Proc. Indian Acad. Sci. A, Vol. 52, No. 1, 1-19 (July, 1960).

An attempt has been made to derive expressions for the ela constants of a substance with cubic symmetry on the basis of no linear theory of elasticity and including up to cubic powers of th strain components in the strain energy function. A simple meth of deriving them directly from the energy function is given for t general case and has been applied to the case of hydrostatic com pression. The notion of an effective elastic energy — the energy required to effect an infinitesimal deformation over a state of finite strain — has been introduced, the coefficients in this expre sion being the effective elastic constants. A separation of this effective energy function into normal co-ordinates has been give for the particular case of cubic symmetry and it has been pointe out that, when any of such coefficients in this normal form beco negative, elastic instability will set in, with associated release o energy.

53

16209 AN INTERNAL FRICTION PEAK DUE TO SLOW MOVING DISLOCATIONS IN IRON-NITROGEN ALLO

R.Rawlings and P.M.Robinson.
Acta metallurgica, Vol. 7, No. 10, 659-63 (Oct., 1959).

A small peak in the internal friction—temperature curve has been observed a few degrees above the Snoek peak (due to stress induced ordering) in iron—nitrogen alloys. The peak is produce when specimens are quenched from above the alpha—gamma tra formation temperature or when specimens quenched from below transformation temperature are lightly strained. It is absent in specimens quenched from below the transformation temperature not strained Evidence is given for the belief that this new peak due to slow moving dislocations.

5

16210 THE ROLE OF VACANCIES IN AN UNUSUAL ANELASTIC PHENOMENON. B.S.Berry.

Acta metallurgica, Vol. 7, No. 11, 741-5 (Nov., 1959).

The internal friction results obtained by Entwistle (1953-4, 1956-7) from a number of quench aging Al alloys are re-examin and interpreted. Two transient contributions to the internal fric are observed on aging duralumin near room temperature. The f contribution develops during the initial hardening, and is deduce be of anelastic origin. It is suggested that this contribution occu by a stress induced rearrangement of clusters of solute atoms, at a rate greatly accelerated by the presence of excess vacancie The second contribution, which develops considerably later in th aging sequence, is also a relaxation phenomenon but with a short relaxation time governed by an activation energy of 13.5 kcal/m and a frequency factor of 10^{14} sec^{-1}. This later relaxation is tho to arise from a stress induced rearrangement of small groups o solute atoms containing vacant lattice sites as an integral compo of their structure. This model successfully explains the salient experimental results, and leads directly to the interpretation of activation energy as that for vacancy motion. The observed seq of changes indicates that the relaxation centres responsible for t contributions occur within the Guinier—Preston zones, and that a spontaneous reorganization within the zones is responsible for th changeover from one contribution to the other.

53

16211 THE EFFECT OF INTERNAL OXIDATION ON THE DAMPING CAPACITY OF COPPER—SILICON ALLO

T.B.Gibbons and S.O'Hara.
Phil. Mag. (Eighth Ser.), Vol. 5, 140-5 (Feb., 1960).

Damping capacity measurements have been carried out on

er—silicon alloy specimens before and after internal oxidation
he results compared with those for oxygen-free, high-conduct-
copper specimens given the same treatment. High damping
s have been noted for the fully internally oxidized copper—silicon
rial and it is suggested that this is caused, to some extent, by
eneration of relatively free dislocations around the silica part-
during the growth and subsequent cooling of these inclusions.

539.3

6212 A NOTE ON SPREAD IN INDENTING.
A.Shutt.

. sci. Res. A, Vol. 9, No. 5, 389-92 (1960).

A solution is derived for the problem of indenting a rectangular
with rough, parallel, square-edged dies. It provides a means of
hly estimating spread in open-die forging of steel. Assuming
the volume of the material remains constant during deformation
orm of the solution is derived in terms of dimensionless para-
rs. Indentation experiments were carried out on bars of
icine and the relevant strains determined. The data were then
to obtain a solution in the theoretical form by statistical
ysis.

A.E.Kay

539.3

6213 CALCULATION OF THE MECHANICAL PROPERTIES OF COLD-ROLLED METALS. G.P.Zaitsev.

. Metallov i Metallovedenie, Vol. 9, No. 1, 103-11 (1960).
Russian.

A method is presented of calculating the tensile strength, yield
t, elongation, and reduction of area of cold-rolled metals from
data on their mechanical properties and on the degree of defor-
tion during rolling. It was found experimentally that the pro-
ed method yields satisfactory results, but only if the cold-
ked metal has not been deformed beyond the point at which
king would start in a specimen of a given metal, subjected to a
ndard tensile test.

M.H.Sloboda

539.3

16214 THE ELASTICITY LIMITS OF TIN AND INDIUM.
N.M.Reinov and A.P.Smirnov.

. tverdogo Tela, Vol. 1, No. 8, 1279-80 (Aug., 1959). In Russian.

An apparatus is described for determining the elastic limit at
ery low temperature by observing the load at which heat is evolved
he specimen due to an irreversible deformation. For tin and
ium at temperatures between 0.1 and 0.3°K, the elastic limits
re respectively less than 1.8 kg/mm^2 and 0.24 kg/mm^2.

R.F.S.Hearmon

539.3

16215 THE DEFORMATION OF LITHIUM, SODIUM AND POTASSIUM AT LOW TEMPERATURES: TENSILE AND SISTIVITY EXPERIMENTS. D.Hull and H.M.Rosenberg.

l. Mag. (Eighth Ser.), Vol. 4, 303-15 (March, 1959).

Stress—strain tests have been made on Li, Na and K at tempe-
ures between 293 and 4.2°K. At higher temperatures the beha-
ur of all three metals is very similar. They are soft and after
yield point very little hardening is observed. At low tempera-
es Li and Na transform to f.c.c. and h.c.p. structures respecti-
y on deformation, the character of their stress—strain curves
nges accordingly and they harden continuously throughout the
t. At 20 and 4.2°K Li deforms with many regions of discontinuous
and at 4.2°K it fractures in a brittle fashion. Whilst K remains
.c. down to 4.2°K it also exhibits an unusual type of hardening at
and 4.2°K which is very temperature dependent. The change
the electrical resistivity during low temperature deformation
s also measured. There was no detectable change when K was
ormed at 4.2°K. This offers further evidence that a large pro-
rtion of the resistivity change which is observed when metals
deformed is due to stacking faults. Both Li and Na give consi-
rable resistivity changes when they are deformed at 4.2°K and
ch of this change is ascribed to the scattering of electrons at
faulted regions within the transformed phases.

539.3

16216 CREEP PROCESSES IN POLYCRYSTALLINE ALUMINIUM. W.A.Rachinger.

ta metallurgica, Vol. 7, No. 6, 374-5 (June, 1959).

Plastic deformation of a polycrystalline aggregate is due to
e or both of two processes, namely, grain deformation and grain
ding. It is shown that in aluminium slowly extended at 300°C
surface of the specimen deforms by grain elongation whilst the
erior deforms by grain sliding. This difference in behaviour
derlines the danger of assuming surface observations typical
the interior

539.3

16217 CREEP OF SOLID AMORPHOUS POLYMERS AT HIGH STRESSES. M.I.Bessonov and E.V.Kuvshinskii.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 265-76 (1959). In Russian.

Polymethyl methacrylate, polymethyl methacrylate with 6% dibutylphthalate, diacetyl cellulose with 20% dibutylphthalate, ebonite, polystyrene, and a copolymer of 85% methyl methacrylate with 50% methacrylic acid were studied at stresses of 3-7 kg/mm^2 at 20°, 40°, 60° and 80°C. All creep curves, plotted as elongation (in %) against the logarithm of time (in sec), had a characteristic S-shape: a slow rise of elongation was followed by a rapid rise and again by a slow rise. Increase of the applied stress and of temperature strongly accelerated the creep rate and reduced the lifetime under load.

A.Tybulewicz

539.3

16218 HIGH-TEMPERATURE CREEP OF GRAPHITE.
D.B.Fischbach.

Nature (London), Vol. 186, 795-7 (June 4, 1960).

A logarithmic equation, $\epsilon = A + B \log t + Ct$, where ϵ is the creep strain, t is time and A, B and C are constants for each test, proposed to describe the creep behaviour of synthetic graphite in the temperature range 1300-2000°C was shown to describe such creep at higher temperatures up to 3000°C. Appreciable differences were found however in the relation of creep to temperature and stress in the two temperature ranges.

R.Hawley

539.3

16219 THE LIFE HISTORY OF INDIVIDUAL SLIP LINES DURING THE PLASTIC DEFORMATION OF α-BRASS SINGLE CRYSTALS. J.T.Fourie.

Acta metallurgica, Vol. 8, No. 2, 88-96 (Feb., 1960).

The development of slip line structures in two α-brass single crystals of different orientation is investigated experimentally with the electron microscope. By using a selected area replica technique, definite areas are photographed repeatedly at intervals of approximately 2% extension in thirty-six stages for one crystal and twenty-six stages for another. The results of average glide and density measurements of slip lines confirm an orientation effect observed in an earlier investigation. This is explained in terms of the formation of Lomer—Cottrell sessile dislocations. Measurements on individual lines indicate that these grow in depth, not continuously, but in definite steps as the extension is increased. These growth steps often occur simultaneously and can be attributed to the production of dislocation bursts by sources activated by strong local fluctuations in the internal stress field around them. As an alternative, a mechanism involving cross-slip between a number of lines is proposed. The formation of cross-slip itself is discussed with reference to successive micrographs of selected areas. These are explained by assuming that a dislocation source is activated on the cross-slip plane as a result of high internal stresses.

539.3

16220 STRESS INDUCED ORDERING AND STRAIN-AGEING IN LOW CARBON STEELS.

D.V.Wilson and B.Russell; appendix by J.D.Eshelby.

Acta metallurgica, Vol. 7, No. 9, 628-31 (Sept., 1959).

Part of the increase in yield stress during the strain-ageing of a low-carbon steel develops too rapidly to be explained by long-range diffusion. The rate at which the initial rapid rise in yield stress develops and the dependence of its magnitude on the dissolved solute content are shown to be those expected from a contribution due to stress-induced ordering of the interstitial solute atoms in the stress fields of dislocations. A simple theoretical treatment gives values in reasonable agreement with experiment.

539.3

16221 THE EQUIVALENCE OF THE PHYSICAL INTERPRETATION OF THE SHAPE OF THE STRESS RELAXATION CURVES. G.N.Kolesnikov and A.I.Moiseev.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 100-2 (1960).
In Russian.

Theoretical. The relaxation phenomena in a specimen subjected to uniaxial tension are discussed. It is shown that the shape of the mean stress/time curves depends on the relative part played by two basic types of physical phenomena: those that result in an increase of the dimensions of the specimen in the direction of the applied stress (e.g. plastic deformation), and those that lead to a contraction of the specimen (e.g. phase transformations).

M.H.Sloboda

539.3

16222 CALCULATION OF THE DISTRIBUTION FUNCTION OF THE RELAXATION TIMES FOR THE ELASTIC AFTER-EFFECT. T.D.Shermergor.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 161-8 (Feb., 1960). In Russian.

Theoretical. The relationship between the characteristics of the relaxation spectrum and the mechanical properties of an elastically deformed body can be described by expressions for the stress (σ), and deformation (ϵ) tensors, derived previously (Abstr. 7553 of 1958) with the aid of thermodynamics of non-reversible processes. A generalized form of these functions is obtained which is applicable to a continuous relaxation spectrum, and formulae derived from which the distribution function of the relaxation times, t, can be calculated from experimental curves of σ (t) and ϵ (t).
M.H.Sloboda

539.3

16223 THE CALCULATED AND EMPIRICAL VALUES OF THE LIFETIME OF METALS AND ALLOYS UNDER LOAD. B.Ya.Pines and A.F.Sirenko.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1043-51 (June, 1960). In Russian.

Empirical data on the lifetime of Sn, Pb, Al, Pt, Ag and Cu under a tensile load were compared with the values calculated using

$$\tau = C\frac{(kT)^2E}{p^3\delta^4D}\ \exp(-p\delta^3n_0^{1/2}/kT)$$

where τ is the lifetime, k Boltzmann's constant, T the absolute temperature, E Young's modulus, p the applied stress, δ the linear atomic dimension, D the self-diffusion coefficient, n_0 the initial number of lattice vacancies representing a crack whose growth leads finally to failure. It was found that the above equation was obeyed by pure metals, but it was not valid for alloys, unless the pre-exponential multiplier was modified.
A.Tybulewicz

539.3

16224 "AFTEREFFECT" IN METAL SPECIMENS WHICH WERE SUBJECTED TO DIFFUSION CREEP AT HIGH TEMPERATURES. B.Ya.Pines and I.G.Ivanov.
Fiz. tverdogo Tela, Vol. 2, No. 5, 959-66 (May, 1960). In Russian.

An aftereffect, i.e. deformation of reverse sign, was observed in cast-metal and cermet specimens previously subjected to diffusion creep at high temperatures, when the applied stress was removed. In Cu specimens the aftereffect/creep-rate ratio was independent of the stress applied, and the aftereffect decreased with rising temperature, becoming zero at the melting point. Apart from the creep rate, the aftereffect depends also on the magnitude of creep deformation: at small deformations the aftereffect/deformation ratio tends to 1; as deformation increases this ratio falls, first rapidly, then slowly, becoming virtually constant at large deformations.
F.Lachman

539.3

16225 STRESS ANALYSIS IN THE PLASTIC RANGE. W.Prager.
Frontiers of numerical mathematics symposium, Wisconsin, 1959 (see Abstr. 12232 of 1960) Paper One, p. 3-15.

Some typical problems are formulated and shown to be equivalent to linear and quadratic programming problems. The applicability of large computers to such problems is discussed.
H.N.V.Temperley

539.3

16226 THE DISSIPATION OF ENERGY DURING PLASTIC DEFORMATION. J.F.Nicholas.
Acta metallurgica, Vol. 7, No. 8, 544-8 (Aug., 1959).

Various mechanisms are considered for the dissipation as heat of the mechanical energy of deformation in a cold-worked metal. Since dislocations seem to account for at most 10 per cent of this dissipation, the creation and annihilation of point defects is considered in some detail. It is concluded that the dissipation may be accounted for satisfactorily in this way.

539.3

16227 ROTARY FLOW OF VISCOPLASTIC MATERIAL OF BINGHAM TYPE. I. FLOW BETWEEN COAXIAL CIRCULAR CYLINDERS. G.Paria.
Bull. Calcutta Math. Soc., Vol. 51, No. 3, 116-22 (Sept., 1959).

The plastic flow of a Bingham solid between coaxial cylinders in relative rotation is discussed in the two cases of uniform rotation and uniform angular acceleration of the outer cylinder, the inner cylinder being fixed. In the non-steady flow, it is assumed that t yield point is everywhere exceeded.
J.G.Oldr

5

16228 VARIATION OF THE STATE OF STRESS IN A SOLID UNDER HYDROSTATIC PRESSURE. A.D.Ekhlakov.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 155-6 (1960). In Russian.

Theoretical. Commenting on a paper by Ryabinin (Abstr. 18 of 1960) the present author points out that, in addition to the case when the hydrostatic pressure (p), is lower than the applied tensi stress, (σ), two other cases of p = σ (the specimen subjected to b axial compression), and p > σ (the specimen subjected to biaxial compression equal to σ and hydrostatic pressure equal to p-σ) sh be considered.
M.H.Slob

53

16229 THE DISPERSION AND RESTORATION OF CONTAC BETWEEN MICROBLOCKS UNDER PLASTIC DEFORMATION. R.I.Garber, I.A.Gindin and L.M.Polyakov.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1089-95 (June, 1960). In Russi

The authors regard the fragmentation of X-ray mosaic struc which accompanies plastic deformation, as a mechanical fragmen tion. An order-of-magnitude argument attributes much of the sto energy of deformation to the surface of microscopic fissures wit the grains. The permeability of deformed iron foils to hydrogen regarded as a measure of their presence. Graphs show the decay of this effect, and of optical scattering in deformed rock salt, as evidence of the associated recovery process.
I.D.C.Gur

539.3 : 539.

16230 THE EFFECT OF THE PHASE DECOMPOSITION OF SUPERSATURATED SOLID SOLUTION ON PLASTIC DEFORMATION. II. NON-UNIFORM DEFORMATION. N.F Syutk
Fiz. Metallov i Metallovedenie, Vol. 6, No. 1, 135-40 (1958). In Russian.

Deals with the stress/strain diagrams of zinc—aluminium (20% Al) alloys in the tempered and aged states, at the same temp tures and deformation velocities (2×10^{-4} and 2×10^{-2} cm/sec) as in Pt I [Fiz. Metallov i Metallovedenie, Vol. 5, No. 3, 508 (195 It is established that (1) the indentations often observed in the stress/strain diagram in a clearly plastic region consist of separ discrete jumps, differing in magnitude on the ascending and desce ding portions of each complex indentation; (2) the total plastic deformation is obtained by adding the separate jumps, the number o which is proportional to the total residual extension. A physical interpretation of the results is given, based on Konobeevskii's the of phase transformations.
D.E.Br

539.3 : 53

THE EFFECT OF PLASTIC DEFORMATION ON THE DIFFU OF HYDROGEN IN NICKEL. See Abstr. 15869

539.3 : 539.2 : 537

PLASTIC-DEFORMATION-INDUCED THERMO-E.M.F. OF C Al AND MILD STEEL. See Abstr. 15999

539.3 : 539.2 :

PLASTIC DEFORMATION IN URANIUM POLYCRYSTALS SUBJECTED TO THERMAL CYCLING. See Abstr. 16254

53

16231 YIELD AND FRACTURE IN POLYCRYSTALLINE NIOBIUM. M.A.Adams, A.C.Roberts and R.E.Smallm
Acta metallurgica, Vol. 8, No. 5, 328-37 (May, 1960).

Tensile tests on specimens prepared from an ingot of electro bombardment melted niobium have shown that the material undergoes a ductile—brittle transition and can be made to twin. The va tion of yield stress σ_y with grain-size 2d has been used to determ the effect of temperature (293°K-20°K at a strain-rate of 2.02×10^{-4} sec^{-1}) and strain-rate ($2.02 \times 10^{-4} - 6.18 \times 10^{-2}$ sec^{-1} 77°K) on the values of σ_i and k_y in a Petch type equation $\sigma_y = \sigma_i + k_y d^{-1/2}$, the results indicating that the ductile-brittle transition characteristics are in accordance with Cottrell's transition equation $(\sigma_i d^{1/2} + k_y)k_y = \beta\mu\gamma$. Niobium shows a greater resistan to brittleness than carburized α-iron because it has a smaller k_y value, and the reluctance of the material to twin except under extreme conditions of low temperature of high strain-rate is also attributed to a low value of k_y. The mechanical behaviour of niob relative to that of other body-centred cubic transition metals is discussed.

539.4

32 THE MECHANICAL PROPERTIES OF IRRADIATED NIOBIUM.

M.J.Makin and F.J.Minter.

etallurgica, Vol. 7, No. 6, 361-6 (June, 1959).
he effect of heavy neutron irradiation (~10^{20} n/cm^2) at 16° C
mechanical properties of niobium has been investigated.
moderate increase in yield strength occurred immediately on
ation (61 000 lb/in.^{2} to ~77 000 lb/in.^{2}) but on annealing in the
ature range 125°-175° C there was a further large increase
e formation of a yield drop at the start of the deformation.
tivation energy has been measured, 1.30 ± 0.1 eV, and it is
ded that the process is due to vacancy migration, the yield
eing due to the condensation on dislocations of vacancies
ed during irradiation. Recovery of irradiation hardening
ences at 350° C and is complete after 1 hr at 600° C. Techno-
lly the most serious irradiation effect is the very large re-
n in uniform elongation before fracture (17% to <2.0%) a conse-
e of a complete lack of capacity to work harden in irradiated
ial. Hence deformation, once started, continues in the same
until fracture occurs. The reduction in area at the fracture
e large in the irradiated material (~50%, cf. 80% in unir-
ed niobium).

539.4

233 THEORETICAL STRENGTH AND CRITICAL RUPTURE STRESS OF SOLIDS.

artenev and I.V.Razumovskaya.
Akad. Nauk SSSR, Vol. 133, No. 2, 341-4 (July 11, 1960).
ssian.
he theoretical strength is the strength realized in an ideal
-free material; the critical rupture stress is the stress devel-
t the apex of a Griffith crack. These two concepts are dis-
d in relation to the proposed model of a crack and to previous
nents of the problem by other workers. R.F.S.Hearmon

539.4

234 SOME PROBLEMS OF THE TIME DEPENDENCE OF THE STRENGTH OF "ORGANIC GLASSES".

azinskaya and E.E.Rȳlov.
verdogo Tela, Vol. 2, No. 5, 967-73 (May, 1960). In Russian.
he effect of air humidity and of the specimen size on the
ce life and the nature of failure in tensile tests was studied,
o were the conditions of "resting" of the "organic glasses"
ined (polymethyl methacrylates and a copolymer of methyl
crylate). The defects caused in the polymers by a protracted
ial tensile stress could be healed only if considerable destruc-
ccurred in the material. F.Lachman

539.4

235 EFFECT OF ORIENTATION ON STRENGTH OF A MODEL SOLID.

A Robinson, J.E.Osborn and C.C.Hsiao.

pl. Phys., Vol. 31, No. 9, 1602-4 (Sept., 1960).
A mathematical analysis given to describe the effect of orienta-
n the variation of the mechanical strength of a model solid.
he simple state of uniaxial orientation the fracture strength in
irection of orientation is evaluated as a function of the degree
ientation in terms of the orientation strain and the strength of
noriented solid. Assuming the fracture strain remains con-
, the maximum fracture strength obtainable for a perfectly
ted solid is found to be six times that of the solid without pre-
d orientation.

539.4

236 THE EFFECT OF GRAIN SIZE ON THE TENSILE PROPERTIES OF HIGH-PURITY MOLYBDENUM AT M TEMPERATURE.

A.A.Johnson.

Mag. (Eighth Ser.), Vol. 4, 194-9 (Feb., 1959).
The room temperature yield and fracture stresses have been
sured for a series of high-purity polycrystalline molybdenum
le specimens with grain diameters varying from 0.03 mm to
mm. The yield stress results can be fitted to Petch's relation
$\sigma_I + k_Y l^{-1/2}$ with $\sigma_I = 11.0$ kg mm^{-2} and $k_Y = 1.7 \times 10^8$ dyne cm$^{-3/2}$.
fracture stress curve tends to a constant height above the yield
s curve as the grain size decreases. Using a theory of fracture
ntly proposed by Cottrell the effective surface energy for
ure is estimated to be 12 000 ergs cm^{-2}.

539.4

237 THE CRACKING ACTIVITY IN ICE DURING CREEP.

L.W.Gold.

d. J. Phys., Vol. 38, No. 9, 1137-48 (Sept., 1960).
Observations were made at one temperature on the cracks that form in ice during creep under constant compressive load. The ice had a hexagonal symmetry with respect to the grain boundaries. The load was applied perpendicular to the long axis of the grains. A piezoelectric crystal was used to detect the cracking activity in the ice. Two stages of cracking were observed. The first occurred during the transient period of the creep, and the plane of these cracks tends to be parallel to the grain boundaries and to the direction of the stress. The rate at which these cracks formed decreased very markedly as the creep rate approached a constant value. Above a certain stress, the creep rate continuously increased with time. Under this condition the second stage of cracking was observed. These cracks tend to be more irregular in direction and to occur in planes that are at 45° to the applied stress.

539.4

16238 THE ORIGIN OF CRACKS IN GLASS DISKS UNDER FIXED VOLTAGES.

M.Hieke.

Z. Naturforsch., Vol. 15a, No. 5-6, 543-6 (May-June, 1960).
In German.

Earlier theories due to Smekal are further developed for brittle solids. C.A.Hogarth

539.4

16239 THE ORIGIN AND DEVELOPMENT OF CRACKS IN DEFORMED CRYSTALS.

L.A.Kochanova, E.D.Shchukin, V.I.Likhtman and P.A.Rebinder.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 71-3 (July 1, 1960).
In Russian.

Two stages are distinguished in the extensional deformation and fracture of metallic single crystals: a rather slow process with the continuous growth of embryonic cracks in regions of high stress concentration, and a rapid process accompanied by loss of stability of the cracks over the whole section of the crystal. During the first stage, deformational inhomogeneities arise, among them the accumulation of dislocations. On the basis of these concepts, equations are given which predict that $c \propto \tau^2$, and $p \propto c^{-1/2}$, where c is the maximum size of crack, τ and p are respectively the shear and normal stress at rupture. These predictions are verified by measurements on amalgamated zinc single crystals of various orientations. See also Abstr. 12834 of 1959; 689 of 1960 and following abstract. R.F.S.Hearmon

539.4

16240 A MECHANICAL CRITERION OF COLD-BRITTLENESS.

N.N.Davidenkov and I.A.Bozhokina.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1319-20 (Aug., 1959). In Russian.

The predicted relationship at fracture (normal stress × shear stress = constant) is verified for polycrystalline molybdenum specimens in bending and shear at −196°C. R.F.S.Hearmon

539.4

16241 ON THE CAUSES OF BRITTLENESS OF VACUUM ANNEALED TUNGSTEN.

I.F.Mikhailov, V.S.Kogan and N.A.Kosik.
Fiz., Metallov i Metallovedenie, Vol. 9, No. 2, 283-7 (Feb., 1960).
In Russian.

The ductility of W was unaffected by annealing at temperatures ≤ 2100° C, when the treatment was carried out in "cold" vacuum, i.e. when the walls of the vacuum chamber were cooled by liquid nitrogen. When normal vacuum technique was used, W wire specimens (0.3 mm dia.) became brittle owing to the formation of a surface W_2C layer; ductility of such specimens could be restored by etching away the W_2C layer. Excessive grain growth in specimens, annealed at temperatures > 2100° C, lowered their ductility. Specimens, annealed above 2500° C, became single crystals and were very ductile. M.H.Sloboda

539 4

16242 THE HARDENING AND EMBRITTLEMENT OF MILD STEEL BY CYCLIC STRESSING AT THE FATIGUE LIMIT.

J.Holden.

Acta metallurgica, Vol 7, No. 6, 380-8 (June, 1959).

The dependence of yield stress at 20° C and fracture stress at −196° C upon grain size has been investigated for a mild steel before and after prolonged cyclic stressing at the fatigue limit. After cyclic stressing the initial slip is coarse, and restricted to planes which have been active in cycling; consequently the hardening revealed by yield and fracture observations is characteristic of the regions of fatigue damage. The cyclic hardening and embrittlement, also investigated by notched impact tests, are not adequately accounted for by processes of ageing and precipitation on the planes active in fatigue.

539.5

16243 ON THE BRITTLENESS OF ZONE-REFINED IRON AT LOW TEMPERATURES.

S.Besnard and J.Talbot.

Acta metallurgica, Vol. 7, No. 7, 517-19 (July, 1959). In French.

Experimental observations are reported which show the effect of purity on the brittle behaviour of polycrystalline specimens of iron at liquid nitrogen temperatures. For metal of high purity, the brittleness depends on the temperature of the preliminary anneal. When this temperature is below a certain value, the material is brittle, but for temperatures above this value deformation occurs by twinning and is followed by plastic deformation. The critical temperature for zone-refined iron is about 650° C. A.E.Kay

539.5 : 539.2 : 537.32

MICROHARDNESS OF PLASTICALLY DEFORMED COPPER.

See Abstr. 15998

539.6

16244 THE RESISTANCE OF DIAMOND TO ABRASION.

E.M.Wilks and J.Wilks.

Phil. Mag. (Eighth Ser.), Vol. 4, 158-70 (Feb., 1959).

The resistance of diamond to abrasion by the conventional method of diamond polishers, using a cast-iron scaife with diamond powder, is extremely sensitive to the orientation of the stone. Thus the rate of removal of material is known to vary by a factor of over a hundred along different directions on a cube face. This anisotropy has been investigated by measurements of the rate of wear on facets in the zone [101]. Other experiments have been undertaken to elucidate the mechanism responsible for the wear. It is concluded that abrasion proceeds as the result of mechanical processes rather than by thermal ones, as has sometimes been suggested. Measurements with a diamond impregnated wheel show that the basic hardness variations on a diamond are comparatively small. The large anisotropy observed with the conventional method is not a fundamental property of the diamond, but is associated with the use of loose powder.

539.6

16245 THE ROLE OF ADHESION IN THE ESTABLISHMENT OF FRICTIONAL FORCES ON PURE SURFACES.

G.I.Epifanov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 349-51 (July 11, 1960). In Russian.

The frictional and adhesive forces of 18 mm diameter hemispherical sliders of ivory, coconut shell, magnesium alloy, iron, brass and copper were measured on freshly prepared surfaces of tin and lead. In the majority of cases, adhesion is not the primary cause of frictional forces, and high friction occurs with both strong and weak adhesion. R.F.S.Hearmon

539.6

16246 ADHESION OF EVAPORATED ALUMINIUM FILMS WITH UNDERLAYERS OF NICKEL, COBALT AND CHROMEL.

C.Weaver and R.M.Hill.

Phil. Mag. (Eighth Ser.), Vol. 4, 253-66 (Feb., 1959).

Thin layers of nickel, cobalt and chromel are evaporated under vacuum on to glass microscope slides and used as underlayers for aluminium films. Adhesion measurements are used to investigate ageing effects which are shown to depend upon temperature as well as the nature and thickness of the underlayer. Results are shown to be due to intermetallic compound formation at the interface causing a type of age-hardening which may result in either decrease or increase in the measured adhesion according to the compound formed and the condition of ageing.

CRYSTALLOGRAPHY

CRYSTAL STRUCTURES

539.2 : 548

16247 ANISOTROPIC TENSORS.

Yu.I.Sirotin.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 321-4 (July 11, 1960). In Russian.

Anisotropic tensors are invariant with respect to all operations in some crystallographic group. A method is given for constructing these tensors as representations of spatial groups of symmetry. J.K.Skwirzynski

539.2

16248 COMPLETE SYSTEMATICS OF POINT GROUPS OF SYMMETRY.

A.V.Shubnikov.

Kristallografiya, Vol. 4, No. 3, 286-8 (May-June, 1959). In Russ
English translation in: Soviet Physics—Crystallography (New Y
Vol. 4, No. 3, 267-9 (March, 1960).

A system of classification of all point groups of classic sym metry is proposed which divides them into two categories. The category includes groups consisting of simple movements (first order symmetry operations) and the second category includes g consisting of simple movements and mirror movements. A furt subdivision is into seven types and into series according to whe the principal axis is odd or even. J.

539.2

16249 THE SIMPLEST METHOD OF DERIVING THE FEDI (SPACE) GROUPS.

N.V.Belov and R.F.Klevtsova.

Kristallografiya, Vol. 4, No. 3, 289-92 (May-June, 1959). In Rus
English translation in: Soviet Physics—Crystallography (New Y
Vol. 4, No. 3, 270-3 (March, 1960).

A method of deriving the 230 space groups, beginning with t orthorhombic ones, is described which is useful for teaching purposes. The method is similar to that of Federov but differs considerably from that of Schoenflies. J

539.2

16250 A GENERALIZATION OF FEDOROV'S STEREOHEI METHOD.

N.M.Bashkirov.

Kristallografiya, Vol. 4, No. 4, 466-72 (July-Aug., 1959). In Ru
English translation in: Soviet Physics—Crystallography (New Y
Vol. 4, No. 4, 442-7 (April, 1960).

Each space-group may be represented by a stereohedron w faces may be curved or plane, and may meet at concave or conv angles, such that space may be filled by repetition of such stere hedra. A.R.St

539.2 :

16251 THE SHUBNIKOV GROUPS.

G.Donnei [Donnay], N.V.Belov, N.N.Neronova and T.S.Smirnova.

Kristallografiya, Vol. 3, No. 5, 635-6 (1958). In Russian. Engl translation in: Soviet Physics—Crystallography (New York), Vo No. 5, 642-4 (Dec., 1959).

A letter from the first-named author to the others points o that, of the 36 P_a groups of the orthorhombic holohedry listed b them, [Trudy Instituta Kristallografii, Vol. 11, 33-67 (1955)] 12 duplicates and 12 others are absent. An example is given to sh that $P_a bmb = P_a ccm \neq P_a maa$. The reply states that these erro have been noted and corrected, and the new set of 12 with refer numbers from the published list (Abstr. 446 of 1958) is given. R.V.C

539.2 :

16252 POSSIBLE CHANGES OF THE SYMMETRY O_h^7 IN PHASE TRANSITIONS OF THE SECOND ORDER.

O.V.Kovalev.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1220-1 (June, 1960). In Russi

As a development of the Landau theory of phase transforma the possible transformations of the space group O_h^7 are listed. R.F.S.Hear

539.2 : 548

RADII OF FIVE PACKED SPHERES IN MUTUAL CONTAC

See Abstr. 14363

539.2

16253 INVESTIGATION OF THE SUB-MICROSTRUCTURE OF DEFORMED NICKEL.

V.M.Kardonskii and M.D.Perkas.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 112-14 (1960). In Russian.

It was found experimentally that increasing the degree of c plastic deformation of electrolytic Ni results, not only in an inc of the distortions of the second order and variation of the size o the regions of coherent scattering, but also in an increase in th angle between the fragmentation products. M.H.Slo

539.2 : 548 : 5

16254 VARIATION OF THE MICROSTRUCTURE OF URANI DURING CYCLIC THERMAL TREATMENT.

R.I.Garber, S.Ya.Zalivadnÿi and V.M.Mikhailovskii.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1052-9 (June, 1960). In Russi

Specimens of polycrystalline U, consisting of large (6 × 0.5

nar grains, were examined during various stages of thermal
g between room temperature and 600°C. Both grain-boundary
nd transcrystalline slip were observed, the two processes
indicated by offsetting (at the grain boundaries) and bending
n the grains) of straight lines (scratches), drawn across several
s prior to thermal cycling. The theoretical magnitude of the
boundary offset, calculated from the data on the relative orien-
of the crystals and the anisotropy of the metal with respect to
efficient of thermal expansion, was by two orders of magnitude
r than the experimental value of approximately 3×10^{-5} per
. Thermal cycling resulted in considerable plastic deformation
the grains (particularly near the grain boundaries) and
d formation of blocks and sub-grains. It was concluded that the
tural changes, observed in polycrystalline U, can be explained
mechanism of a "thermal ratchet", postulated by Burke et al.
milar phenomena taking place in bi-crystals; this mechanism
nes more complex in polycrystalline material owing to the
ing action of the adjoining grains. M.H.Sloboda

539.2 : 548

255 MAKING NaI:Tl CRYSTALS WITH HOLES.
R.Voska.

tallografiya, Vol. 4, No. 2, 260 (March-April, 1959). In Russian.
sh translation in: Soviet Physics—Crystallography (New York),
4, No. 2, 239 (Feb., 1960).
A note on a method used to make holes in crystals by dissolution.
D.G.Holloway

539.2 : 548.5

256 A CONTRIBUTION TO THE MECHANISM OF NaCl
CRYSTAL GROWTH. B.Jeszenszky.

phys. Hungar., Vol. 8, No. 1-2, 147-60 (1957). In German.
Microscopic investigations showed formation of spiral hills at
grain boundaries of a rapidly solidifying melt of NaCl. Etching
atural and synthetic NaCl should decide whether screw disloca-
s play an important part in the crystallization of NaCl. The best
ares resulted from crystals grown from the melt. The etch-
res were very similar to those obtained by thermal methods
were the same as those found by other authors for crystals of
CdI_2, n-paraffin grown both from solution and from vapour.
H.E.Schmid

539.2 : 548.5 : 541.12

6257 REACTION RATE AND GROWTH FORMS OF REACTION
PRODUCT IN THE SYSTEM $Ag-H_2S$.

ischmeister and J.Drott.
metallurgica, Vol. 7, No. 12, 777-81 (Dec., 1959).
In the system $Ag-H_2S$ at room temperature, the growth form of
reaction product is found to exert a decisive influence on the kine-
of the reaction. The initial stage is characterized by a cubic
law and by the nucleation and growth of irregularly distributed
nds of sulphide on the silver surface. In the next stage, there is
dden increase of the reaction rate, accompanied by the appearance
eedles perpendicular to the metal surface. During the third
e, the reaction rate decreases again while fewer and fewer
dles continue to grow. The length of the largest needles observed
his study was ~20 μ, corresponding to about twenty times the
imum possible thickness of a compact bottom layer. Although
r volume accounts for only a fraction of the total amount of
hide formed, the needles are thought to be decisive in determining
reaction rate after the initial stage.

539.2 : 548.5

6258 THEORY OF NON-EQUILIBRIUM PICK-UP OF
IMPURITIES DURING CRYSTAL GROWTH. A.A.Chernov.

. Akad. Nauk SSSR, Vol. 132, No. 4, 818-21 (June 1, 1960).
ussian.
The pick-up coefficient of impurities is derived assuming that
growth of a crystal is caused by the successive deposition on its
ace of new layers of equal thickness in equal time intervals and
the velocity at which the steps of layers move is infinite
pared with the rate of diffusion of the impurity in the crystal.
expressions are obtained, for $V \gg D/h$ and $V \ll D/h$, where V
e normal growth rate of the crystal face, h is the thickness of
layer, and D is the coefficient of diffusion. F.Lachman

539.2 : 548.5

16259 INVESTIGATION OF THE GROWTH OF A LEAD SUL-
PHIDE LAYER AT THE INTERFACE OF LEAD WITH
UID SULPHUR. V.A.Dorin and G.M.Filaretova.

. Metallov i Metallovedenie, Vol. 9, No. 2, 195-201 (Feb., 1960).
Russian.
Experiments, carried out between 175 and 300°C, showed that the rate of growth, K, of the PbS layer formed at the solid lead—liquid sulphur interface is time-independent and increases exponentially with rising temperature. K decreased when Pb contained approximately 1.0 at % Sn, Cd, or Zn, and increased when O, Se, or Te were present in the sulphur. The formation of PbS only took place at the interface which resulted in unidirectional growth of the PbS layer. M.H.Sloboda

539.2 : 548.5

16260 DIRECTIONS OF GROWTH STRIATIONS IN GERMANIUM CRYSTALS. A.C.English.

J. appl. Phys., Vol. 31, No. 8, 1498-1500 (Aug., 1960).

Two experimental situations are reported: (a) a Ge wafer is heated for a few minutes at 700°C in contact with one of several metals, and (b) indium is alloyed on the surface of Ge at 550°C and then the indium is dissolved off. In each case marked effects due to growth striations resulting from fluctuations in impurity concentration are observed. C.A.Hogarth

539.2 : 548.5

16261 THE EFFECT OF IMPURITIES ON THE GROWTH OF SYNTHETIC QUARTZ. C.S.Brown and L.A.Thomas.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 337-43 (June, 1960).

An investigation has been carried out aimed at developing a process for the growth of large crystals of synthetic quartz using silica-rich rocks native to the United Kingdom as the raw material. As a result of this work the effect of impurities on the habit and quality of the crystals has been determined. The role of aluminium as a key impurity has been proved and the darkening produced by X-irradiation has been used to study the distribution of impurities in the synthetic quartz. Recent work has thrown further light on the manner in which aluminium, possible associated with another element, is incorporated in the quartz structure.

539.2 : 548.5

16262 THE QUESTION OF THE INFLUENCE OF PECTIN ON THE CRYSTALLIZATION OF AMMONIUM CHLORIDE.

V.I.Melik-Gaikazyan and I.Ya.Melik-Gaikazyan.
Kristallografiya, Vol. 4, No. 3, 435-7 (May-June, 1959). In Russian.
English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 409-12 (March, 1960).

Describes the influence of pectin on the solubility of ammonium chloride. It does not affect the measured solubility but does extend the temperature range over which supersaturation of an aqueous solution is observed. Consequently the formation of large single crystals from solution is favoured. C.A.Hogarth

539.2 : 548.5

16263 A MECHANISM FOR SECONDARY RECRYSTALLIZATION IN HIGH-PURITY SILICON IRON. J.L.Walter.

Acta metallurgica, Vol. 7, No. 6, 424-6 (June, 1959).

Four possible mechanisms for texture selection are listed, and the experiment described was performed to isolate one of the mechanisms from the other three which are related to one another. The results show that the isolated mechanism accounts for the sharp alignment of the cube planes with respect to the plane of the surface of the sample. S.Weintroub

539.2 : 548.5

16264 INVESTIGATIONS ON A NEW KIND OF SECONDARY RECRYSTALLIZATION IN Fe—3% Si ALLOYS. K.Detert.

Acta metallurgica, Vol. 7, No. 9, 589-98 (Sept., 1959). In German.

A case of secondary recrystallization not observed until now is reported, where the sample thickness stops the normal grain growth before two-dimensional selective growth begins. As is concluded from theoretical considerations, the experimental results are consistent with the hypothesis, that the selective growth is due to differences in surface energy of the different crystallographic surfaces.

539.2 : 548.5

16265 RECRYSTALLIZATION OF BERYLLIUM.
A.A.Kruglÿkh, V.S.Pavlov and G.F.Tikhinskii.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 148-51 (1960).
In Russian.

Reports a study of recrystallization of finely-grained Be (99.98% purity), deformed by cold rolling to 25% reduction in thickness, and of grain growth in recrystallized specimens, heat-treated isothermally between 800 and 1000°C. The activation energies were $Q_P = 21 \pm 3$ kcal/g-atom for the former, and $Q_G = 37 \pm 4$ kcal/g-atom for the latter process. M.H.Sloboda

539.2 : 548.5

16266 DETERMINATION OF THE RECRYSTALLIZATION TEMPERATURE OF METALS. P.K.Verborenko.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 154-5 (1960). In Russian.

Theoretical. An empirical formula $T_p \approx \delta_1 T_n$ (where T_p and T_n are the recrystallization temperature and the melting point, respectively), due to Bochvar, and a theoretical expression, derived by V.L.Shmarts (Abstr. 3939 of 1958), are discussed. It is shown that the variation of δ_1 (between 0.35 and 0.45) is associated with the variation of the term Q/T_n (where Q is the Debye temperature), appearing in the theoretical formula. M.H.Sloboda

539.2 : 548.5 : 532.7

16267 REDUCED TEMPERATURES FOR NUCLEATION IN SUPERCOOLED LIQUIDS. E.R.Buckle.

Nature (London), Vol. 186, 875-6 (June 11, 1960).

A parallelism between ($T_f - \Theta$) and T_f is noted where T_f is the absolute melting temperature (of a pure substance), Θ the critical supercooling, and $T_f - \Theta = T_s$ the freezing threshold. From data covering a wide variety of substances T_s/T_f is found to be 0.82 and the constancy of this value shows that the sizes of crystal nuclei, as measured by the number of molecules comprising them, are the same to within an order of magnitude for all the compounds examined. The number is calculated to be about 300. W.Good

539.2 : 548.5

16268 PREPARATION OF HIGH PURITY SINGLE CRYSTAL SILICON. THE FLOATING-ZONE TECHNIQUE.

J.L.Parmee.

Engineer, Vol. 209, 979-82 (June 10, 1960).

The effect on crystal conductivity of the presence of impurity atoms is considered and a relationship derived between the electrical conductivity and the concentration of impurities. Crystal pulling from a melt in a crucible of pure transparent fused quartz imposes a limit on crystal purity by the small traces of undesirable impurity elements in even the purest fused quartz. Zone melting by means of a h.f. field is one of the methods used to overcome this contamination. A floating-zone refiner is described and its importance stressed both in ensuring the supply of consistently good crystals for device material and in the solution of three problems of crystal physics.

539.2 : 548.5

16269 APPARATUS FOR MICROSCOPIC INVESTIGATION OF THE GROWTH OF CRYSTALS FROM SOLUTIONS.

M.I.Kozlovskii.

Kristallografiya, Vol. 3, No. 4, 509-10 (1958). In Russian. English translation in: Soviet Physics–Crystallography (New York), Vol. 3, No. 4, 513-15 (July-Aug., 1958).

Brief description of the apparatus and technique used for growing crystals at constant temperature and supersaturation with continuous replenishment of the solution. D.G.Holloway

539.2 : 548.5

16270 SOME MODIFICATIONS IN CRYSTAL GROWING METHODS.

L.M.Belyaev, B.V.Vitovskii and G.F.Dobranskii.

Kristallografiya, Vol. 4, No. 5, 791-4 (Sept.-Oct., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 5, 749-52 (May, 1960).

Notes on: (1) use of an auxiliary heater in the melt in the Stockbarger method to maintain even growth; (2) design of an evaporation crystallizer with a device to enable prolonged operation; (3) design of furnace for growing crystals by the Verneuil method under controlled atmosphere. D.G.Holloway

539.2 : 548.5

16271 THE PREPARATION OF SMOOTH SINGLE CRYSTAL SURFACES OF SILVER BY AN EVAPORATION TECHNIQUE. D.W.Pashley.

Phil. Mag. (Eighth Ser.), Vol. 4, 316-23 (March, 1959).

An electron diffraction study has been made of the growth of evaporated silver layers on cleaved mica surfaces, with the substrate at various temperatures during the deposition. It is shown that good orientation (epitaxy) occurs over a wide range of temperatures, but that the nature of the orientation depends upon both the substrate temperature and the film thickness. Under certain conditions of preparation it is found that the surface of the silver deposit is very smooth on an atomic scale. These surfaces are of value as substrates for other experiments, both on epitaxy and on specimen preparation for high resolution electron microscopy of metals, and examples of these applications are quoted.

539.2 : 5

16272 AUTOMATIC DEVICE FOR ZONE REFINING OF ME AND SEMICONDUCTORS. W.Giriat and Z.Dziuba.

Acta phys. Polon., Vol. 18, No. 6, 589-92 (1959).

Description of apparatus in which the sample is oscillated at
adjustable rate in the field of several resistance heating element
Mechanical stirring of the molten zones is effected electromagne
cally and the whole system can be tilted to compensate for trans
of material. D.G.Hollo

539.2 : 5

16273 GRAIN GROWTH IN ZONE-REFINED TIN. E.L.Holmes and W.C.Winegard.

Acta metallurgica, Vol. 7, No. 6, 411-14 (June, 1959).

Grain growth experiments have been performed with zone-
refined tin of very high purity. A single growth law obeying the
simple $t^{1/2}$ relation was obtained over the range of temperatures
167°-220° C. The activation energy for grain growth was calcula
to be 6.0 ± 0.6 kcal/g atom, which is comparable to the previous
result of 6.7 ± 0.7 kcal/g atom on zone-refined lead. Applicatio
of the equation for grain growth, as developed by Burke and Turr
yielded free energies of activation comparable in magnitude to
those obtained in liquid self-diffusion.

539.2 : 5

16274 THE NUCLEATION OF NICKEL WHISKERS. R.E.Cech.

Acta metallurgica, Vol. 7, No. 12, 787-92 (Dec., 1959).

The nucleation step in the formation of nickel whiskers by
hydrogen reduction of halide salts was examined. The finding o
Gorsuch that whiskers were nucleated on an oxide were confirm
and it was demonstrated that the nucleation step for whisker for
tion was the hydrogen reduction of nickel oxide on metal.

539.2 : 5

16275 GROWTH OF SILVER SULPHIDE WHISKERS. J.Drott.

Acta metallurgica, Vol. 8, No. 1, 19-22 (Jan., 1960).

The filament growth on silver after reaction with hydrogen
sulphide at room temperature has been studied by electron micr
scopy and electron diffraction. The filaments are β-silver sulph
and grow from the tip. The growth direction of a long whisker w
$[\bar{4}14]$. The elastic strain on a curved whisker was found to be ab
1.3 per cent. Many of the whiskers display offset portions and
branches. Kinks often sprout small irregular whiskers. Interru
tion of the sulphidation reaction seems to influence the morpholo
of the whiskers on further sulphidation. It is suggested that the
whiskers grow on mounds having a much less perfect structure t
the whiskers themselves.

539.2 : 54

16276 DENDRITIC INCLUSIONS IN AlSb GROWN-JUNCTIC DIODES. H.C.Gorton.

J. Electrochem. Soc., Vol. 107, No. 3, 248-9 (March, 1960).

Fibres of Al_3Ta have been observed in AlSb grown junctions
A mechanism is suggested to account for the formation of these
inclusions. C.D.

539.2 : 5

16277 GROWTH OF CUPRIC OXIDE NEEDLES AND THE DETERMINATION OF THEIR RATE OF GROWTH.

W.D.Dachselt and G.Pfefferkorn.

Z. Naturforsch., Vol. 15a, No. 5-6, 412-17 (May-June, 1960). In Ge

Gives a full investigation of the preparation of CuO whisker
between 200 and 300°C. Growth direction was $\langle 110 \rangle$ and the sec
was a six-sided prism. The growth rate was linear and increas
exponentially with temperature. Conditions favouring the format
of CuO needles (or whiskers) are discussed. C.A.Hog

539.2 : 5

16278 APPEARANCE OF DISLOCATIONS IN METAL CRYST ON EVAPORATION: TWINNING DISLOCATIONS AND THEIR RELATION TO ANNEALING TWINS IN COPPER.

E.Votava and A.Berghezan.

Acta metallurgica, Vol. 7, No. 6, 392-8 (June, 1959).

Evaporation of copper surfaces produces a step-structure w
is related to the orientation of the crystals. On non-coherent tw
boundaries this step-structure takes up a characteristic aspect
which two cases can be distinguished, namely; (a) simple or mu
evaporation spirals, or (b) evaporation channels. An interpretat
in terms of twinning dislocations is given. Furthermore, the se
of the spirals is determined by the direction of the displacement

n -coherent twin boundary. This is due to the twin dislocation hich are confined in the {111} planes and have opposite signs wo emergence points.

539.2 : 548.5

79 TWINNING AND FRACTURE OF SINGLE CRYSTALS OF 3% SILICON IRON. D.Hull.

etallurgica, Vol. 8, No. 1, 11-18 (Jan., 1960).

in sheet single crystal (001) specimens of a 3% silicon iron een strained in tension at −196° C in the [010] direction. Twins d, in preference to slip, on four prominent planes $(1\bar{2}1)$, $(1\bar{2}1)$, and (121)m which are all equivalent with respect to the applied . The morphology of the twins has been studied. They are in l parallel sided, but at the free surface one side of the twin is h and the other has a characteristic zig-zag marking. The ngs are steps on the surface which are probably produced by process. The crystals fractured without measurable deform- as a result of (010) cleavage cracks nucleated at the inter- n of twins. Only intersections in which the twins meet on a normal to the applied stress produced cracks. The (010) s were often deflected along twin interfaces; on the zig-zag f the twin the crack followed the twin interface and on the h edge a stepped crack of (010) and (100) cleavage facets was ced.

539.2 : 548.5

280 DECORATION AND ETCHING OF SILVER-DOPED ROCKSALT CRYSTALS BY SURFACE GAS REACTIONS.

ntinck and W.Dekeyser.

metallurgica, Vol. 7, No. 6, 389-91 (June, 1959).

Silver-doped rocksalt crystals were treated with different carbons and with a mixture of CH_4 and O_2 at higher tempera- . Besides decoration of dislocations and in some cases cavity ation, spiral etch-pits were formed after a treatment with and O_2. The decoration is due to electrons from hydrogen ee radicals. The spiral etch-pits are presumably formed inhomogeneous concentration of reaction products in the ous vapour phase round an active site.

539.2 : 548.5

6281 OBSERVATIONS ON REGULAR ARRAYS OF ETCH PITS IN A TITANIUM–10% MOLYBDENUM ALLOY.

Schofield and A.E.Bacon.

metallurgica, Vol. 7, No. 6, 403-6 (June, 1959).

Regular arrays of etch pits observed in rapidly cooled Ti–10% Mo s are considered to indicate the sites of unstable groups of dislo- ns which collapse, at slower rates of cooling, into a more stable ork of sub-grain boundaries.

539.2 : 548.5

6282 ETCHING TECHNIQUES FOR DISLOCATIONS IN Fe–Ni ALLOYS. W.D.Hannibal.

metallurgica, Vol. 7, No. 10, 697-9 (Oct., 1959). In German.

Gives some recipes for the electrolytic etching of Fe–Ni alloys ow dislocation etchpits. H.Mykura

539.2 : 548.5

6283 DISLOCATION ETCH PITS AND PLASTIC DEFORMATION IN CALCITE. R.E.Keith and J.J.Gilman.

metallurgica, Vol. 8, No. 1, 1-10 (Jan., 1960).

This investigation was concerned with the development of an -pitting procedure for calcite crystals ($CaCO_3$). Calcite is of rest because of its plastic properties, expecially its capacity mechanical twinning. Etch pits were produced on calcite using mber of different reagents. The pits were found to have unique es characteristic of each chemical, its concentration, and the re of any diluent used with it. Concentrated formic acid pro- d the most satisfactory pits, and it was verified that these pits lted from dislocations. The known glide elements of calcite confirmed by observing arrays of etch-pits on the glide planes. ocation structures were observed in twins

539.2 : 548.5

6284 ETCH PITS IN PYROLYTIC GRAPHITE. A.Tarpinian and G.E.Gazza.

pl. Phys., Vol. 31, No. 9, 1657-8 (Sept., 1960).

The observation of etch pits in pyrolytic graphite after ion- bardment etching is described and their similarity to dislocation pits is speculated. Evidence of etch-pit multiplication in the of slip-line segments and low-angle tilt boundaries is presented.

539.2 : 548.5

16285 TOPOGRAPHY AND ETCH PATTERNS OF SYNTHETIC QUARTZ. F.Augustine and D.R.Hale.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 344-6 (June, 1960).

The surfaces of synthetic quartz crystals show many details of growth patterns. Growth hillocks with spiral ramps are often found on rhombohedral faces and on the irregular surface of growing basal pinacoids (00.1). In some instances small hillocks are replaced through etching by pits in a substantially one-to-one relationship.

539.2 : 548.5

16286 VACUUM THERMAL ETCHING OF TWINNED ZINC MONOCRYSTALS. G.B.Rais and M.I.Bromberg.

Kristallografiya, Vol. 4, No. 4, 594-6 (July-Aug., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 555-7 (April, 1960).

Elementary observations on etch-pit distribution.

D.G.Holloway

539.2 : 548.7

16287 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON X-RAY ANALYSIS, LONDON, NOVEMBER 1959.

G.J.Bullen and A.L.Mackay.

Brit. J. appl. Phys., Vol. 11, No. 9, 393-400 (Sept., 1960).

The Autumn Conference of the X-ray Analysis Group of The Institute of Physics was held at The Institution of Civil Engineers, London, on 13 and 14 November, 1959. The topics under discussion were "Structure analysis" and "Apparatus and experimental techniques".

539.2 : 548.7

16288 DETERMINATION OF THE ORIENTATION OF MOSAIC BLOCKS BY MEANS OF A FINE-FOCUS X-RAY TUBE.

J.Auleytner.

Acta phys. Polon., Vol. 17, No. 2-3, 111-16 (1958).

An X-ray tube having a point focus of effective diameter 40 microns is used. The radiation falls on a narrow slit between two 8 mm diameter cylinders, and the emergent beam is incident on the crystal under investigation. Two photographs are made of a suitable diffraction line: (i) with the crystal oscillating and the film stationary, and (ii) with the motion of the film coupled to the motion of the crystal. In this way the disorientation of the blocks of the mosaic can be determined for angles greater than 30 sec and, in particular cases, of twists of the order of seconds. The method permits the obtaining of a picture of the mosaic structure over a large area of monocrystal in a relatively short time, and the disclosure of the direct dependence of the Bragg line intensity on the mosaic structure. R.V.Coates

539.2 : 548.7

16289 SIMPLE HIGH TEMPERATURE X-RAY CAMERA. G.Farrow and D.Preston.

J. sci. Instrum., Vol. 37, No. 8, 305 (Aug., 1960).

The paper describes the construction of an X-ray diffraction camera for heating specimens up to temperatures of 270° C with a constancy of ±1°. A material known as "Agalain" was used for the construction of the furnace, which is designed to be used in conjunction with a Unicam S25 X-ray goniometer. T.Mulvey

539.2 : 548.7

16290 THE X-RAY PULSE DIFFRACTOMETER. V.V.Sanadze.

Kristallografiya, Vol. 4, No. 3, 365-71 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 339-44 (March, 1960).

Describes a recorder used with the diffraction-unit URS-251 and the goniometer GUR-2. Pulses from the counter are recorded in terms of the displacement of a line produced photographically on a rotating drum. A.R.Stokes

539.2 : 548.7

16291 AN X-RAY CAMERA FOR THE STUDY OF CRYSTALS OVER THE RANGE −175° C TO +300° C.

N.N.Zhuravlev and A.A.Katsnel'son.

Kristallografiya, Vol. 3, No. 5, 632-4 (Sept.-Oct., 1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol.3, No. 5, 639-41 (Dec., 1959).

The camera is of simple construction, the specimen being heated by hot air or cooled by cold nitrogen. It was tested by using it to obtain experimental f-curves for Ni at three temperatures.

A.R.Stokes

539.2 : 548.7

16292 APPARATUS FOR NEUTRON DIFFRACTION STRUCTURAL ANALYSIS. I.I.Yamzin.

Kristallografiya, Vol. 4, No. 3, 423-5 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 397-9 (March, 1960).

Describes a conventional neutron diffractometer for the examination of single crystals. The equipment incorporates a Pb crystal monochromator, a BF_3 proportional counter and remote-reading devices. J.Thewlis

539.2 : 548.7 : 539.12

A UNIVERSAL DOUBLE-CRYSTAL NEUTRON SPECTROMETER.

See Abstr. 15369

539.2 : 548.7

16293 LOW-TEMPERATURE CRYSTAL HOLDER FOR THE EG ELECTRON-DIFFRACTION CAMERA.

V.F.Dvoryankin and B.K.Vainshtein.

Kristallografiya, Vol. 3, No. 4, 504-6 (1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3, No. 4, 507-9 (July-Aug., 1958).

There are two protective chambers, independently cooled by liquid nitrogen, the specimen being held inside the inner one. The device combines wide electron-beam apertures with freedom from icing on the specimen. A.R.Stokes

539.2 : 548.7

16294 SMALL-ANGLE DIFFRACTION WITH ELECTRON BEAMS. H.Mahl and W.Weitsch.

Naturwissenschaften, Vol. 47, No. 13, 301-2 (1960). In German.

Describes the use of an AEG-Zeiss electron-microscope in order to obtain d-values up to 1000 A. A.R.Stokes

539.2 : 548.7

16295 COMMENTS ON THE PAPER BY SCHEIBNER, GERMER AND HARTMAN: "APPARATUS FOR DIRECT OBSERVATION OF LOW ENERGY ELECTRON DIFFRACTION PATTERNS".

H.E.Farnsworth.

Rev. sci. Instrum., Vol. 31, No. 7, 795 (July, 1960).

See Abstr. 4613 of 1960. The stability of the crystal surface during measurement and the effects of contaminants are discussed. The advantages of recording selected parts of the diffraction pattern by the current measuring method, as distinct from the direct photography of the complete pattern, are re-emphasized. R.Reed

539.2 : 548.7 : 545

16296 CRYSTALLOGRAPHIC ASPECTS OF EXTRA REFLECTIONS IN X-RAY SPECTROCHEMICAL ANALYSIS.

N.Spielberg and J.Ladell.

J. appl. Phys., Vol. 31, No. 9, 1659-64 (Sept., 1960).

In X-ray spectrochemical analysis, a given crystal monochromator can give rise to higher-order reflections of the incident wavelength, which may be ascribed to the planes (nh nk nl), which are parallel to the principal planes (hkl). In addition to these, however, there may occur reflections due to other sets of planes which are slightly tilted with respect to (hkl). These reflections may lead to undesirable spectral interferences. The identification of these undesirable reflections and their dependence upon choice of various angular divergence parameters, on wavelength, and on the selection and orientation of the monochromators are discussed in terms of an instrumental figure of reflection and a detecting volume in reciprocal space. Topaz and quartz are used as specific examples of the problem.

539.2 : 548.7

16297 RENNINGER EFFECT IN NAPHTHAZARIN. P.Srivastava.

Indian J. Phys., Vol. 33, No. 3, 123-6 (March, 1959).

While studying the space group of naphthazarin, the Renninger effect has been observed in a highly exposed zero-layer [010] Weissenberg photograph. This has been completely verified by construction of reciprocal lattice, and by calculation, and the space group of the crystal has been definitely established.

539.2 : 548.7

16298 ONE-DIMENSIONAL X-RAY DIFFRACTION IN THE X-RAY PATTERNS OF POLYMERS.

A.I.Kitaigorodskii and D.Ya.Tsvankin.

Kristallografiya, Vol. 4, No. 4, 625-7 (July-Aug., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 585-6 (April, 1960).

It is shown, from theoretical considerations, that in X-ray diffraction from chain-like substances it is possible to obtain continuous blackening along the layer lines even when there are only slight deviations from strict spatial order, if such deviations are caused by defects in the spatial packing of the chains. Thus, in the diffraction pattern from a long chain polymer this "one dimensiona scattering" might be explained without, in every case, assuming that the arrangement perpendicular to the chain length is a random one. I.Iba

539.2 . 548

16299 X-RAY AND THERMAL-NEUTRON SCATTERING NEAR A SECOND-ORDER PHASE TRANSITION POINT

M.A.Krivoglaz.

Kristallografiya, Vol. 4, No. 3, 312-14 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 290-2 (March, 1960).

A brief summary of the theory of the phenomenon with referenc to published experimental work. J.Thewli

539.2 : 548.

16300 THE SUPERPOSITION METHOD OF SOLVING CRYSTAL STRUCTURES. V.I.Simonov.

Kristallografiya, Vol. 4, No. 3, 302-11 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 281-9 (March, 1960).

The superposition method is taken to mean all methods of interpreting the Patterson function in which that function is conside as the result of repeated stacking of the same structure with parallel displacements between successive units. The method is discussed in detail, and its relationship to the determination of pha relationships by more direct methods is brought out. Examples ar given of the use of the method in individual structure determination J.Thewli

539.2 : 548.

16301 CALCULATION OF MICRODEFORMATIONS AND OF BLOCK SIZES BY MEANS OF HARMONIC ANALYSIS OF THE SHAPES OF THE X-RAY DIFFRACTION LINES GIVEN BY POLYCRYSTALS. V.D.Krȳlov.

Kristallografiya, Vol. 4, No. 4, 627-8 (July-Aug., 1959). In Russian English translation in: Soviet Physics—Crystallography (New York Vol. 4, No. 4, 587-8 (April, 1960).

Formulae are given to calculate the Fourier coefficients $A_n = A_n^{\partial} A_n^{u}$ and the root mean square displacement, for a polycrystalline material, giving full information about the micro-defor ations and sizes of uniformly deformed regions. C.Turner

539.2 : 548

16302 ATOMIC SCATTERING FACTORS FOR ELECTRONS FOR THE ELEMENTS OF THE THIRD PERIOD.

B.K.Vainshtein and Dzh.A.Aibers [J.A.Ibers].

Kristallografiya, Vol. 3, No. 4, 416-19 (1958). In Russian. English translation in: Soviet Physics—Crystallography (New York Vol. 3, No. 4, 417-20 (July-Aug., 1958).

Values for atoms from Na to A were calculated from recent data [Abstr. 9268 of 1955 and Ibers, Acta Cryst., Vol. 11, Pt 3, 178 (1958)]. Scattering factors are tabulated for atoms from H to A and for sin θ/λ from 0 to 1.0 A^{-1}. A.R.Stoke

539.2 : 548.

16303 AN EXPANDED TABLE OF ATOMIC SCATTERING AMPLITUDES FOR ELECTRONS BASED ON THE STATISTICAL MODEL INCLUDING EXCHANGE.

Dzh.A.Aibers [J.A.Ibers] and B.K.Vainshtein.

Kristallografiya, Vol. 4, No. 5, 641-5 (Sept.-Oct., 1959). In Russia English translation in: Soviet Physics—Crystallography (New York Vol. 4, No. 5, 601-5 (May, 1960).

Tables are given for values of sin θ/λ from 0 to 1.5 A^{-1} and atomic numbers from 20 to 104. A.R.Stoke

539.2 : 548.

16304 THE STRUCTURE COEFFICIENTS OF THE INTERNAL FIELD IN PEROVSKITE-TYPE FERROELECTRICS.

Yu.N.Venevtsev, S.P.Solov'ev and G.S.Zhdanov.

Kristallografiya, Vol. 4, No. 4, 575-8 (July-Aug., 1959). In Russian. English translation in: Soviet Physics-Crystallography (New York). Vol. 4, No. 4, 538-40 (April, 1960).

A previous paper (Abstr. 5859 of 1958) gave the structure coefficients for the internal field in perovskite-type ferroelectrics for various orientations of the dipoles. The relation between the $S_z(xyz)$ and C_{ik} for dipoles oriented on [001] can be extended to dipoles oriented on [011] and [111]. To assist the derivation, tables of $S_l(xyz)$ [l = 1,2,3,] versus C_{ik}, and projections of

cture coefficients for various orientations of the dipoles are
The formula for the field at the origin given by an infinite
f dipoles is quoted, and $S_l\,(0\frac{1}{2}\frac{1}{2})$ and $S_l\,(\frac{1}{2}00)$ for orientation
are derived to show the construction of the table.

R.V.Coates

539.2 : 548.7

5 ON THE CONSTRUCTION OF THE LATTICE OF IONIC CRYSTALS FROM THE VIEWPOINT OF CLOSE
NG. K.Sasvári.

ys. Hungar., Vol. 8, No. 1-2, 245-59 (1957).

e existence of polymorphism in ionic crystals is examined
stigate whether there is a connection between the geometry
rystal lattice and chemical composition. The simplest
lattices of compounds of the type AX can be constructed
basis of close packing with the aid of Pauling's coordination
le, by assuming an even distribution of the constituent ions
dividing the crystal lattice into close-packed ionic planes.
entred cubic lattices of some elements are explained as
. consequence of two kinds of electron configurations in
ne metallic atoms resulting in a lattice of the CsCl type.

J.Iball

539.2 : 548.7

06 A THEORY OF ORDERING OF ALLOYS WITH HEXAGONAL CLOSE-PACKED LATTICE.

atȳsina and A.A.Smirnov.

erdogo Tela, Sbornik [Supplement] II, 286-90 (1959).
sian.

erives the temperatures of ordering for hexagonal close-packed
of AB and AB_3 types in terms of interatomic interaction
nts and alloy compositions. A.Tybulewicz

539.2 : 548.7

07 COMMENTS ON CARPENTER'S PAPER "DENSITY OF THE BONDING ELECTRONS IN DIAMOND". J.A.Ibers.

m. Phys., Vol. 33, No. 1, 299-300 (July, 1960).

ee Abstr. 4626 of 1960. An electron-density map was calculated
w the effect of overlap of electrons of adjacent carbon atoms,
is concluded that Carpenter's results cannot distinguish
en overlap and bonding. A.R.Stokes

539.2 : 548.7

308 DENSITY OF BONDING ELECTRONS IN DIAMOND. G.B.Carpenter.

m. Phys., Vol. 33, No. 1, 300-1 (July, 1960).

ee Abstr. 4626 of 1960 and preceding abstract. A re-calculation
electron-density difference synthesis, using improved values
form factor of carbon, shows little evidence for movement of
ons into bonds, in agreement with Ibers' view. A.R.Stokes

539.2 : 548.7

309 ANISOTROPY IN THE ELECTRON DENSITIES OF ATOMS IN DIAMOND-TYPE CRYSTALS. K.P.Mamedov.

allografiya, Vol. 4, No. 4, 624-5 (July-Aug., 1959). In Russian.
sh translation in: Soviet Physics—Crystallography (New York),
, No. 4, 583-5 (April, 1960).

-ray measurements are reported for diamond and silicon. The
ve intensities of 222 and 622 in Si are much weaker than those
mond. This may indicate that the bonds are weaker in Si. In
nd the ratio of intensity of 622/333 is larger than in Si. This
mean the charge in Si is more diffuse than in diamond.

S.Tolansky

539.2 : 548.7

310 STRUCTURAL AND GEOMETRICAL RELATIONS BETWEEN α- AND β-TITANIUM, THE ω-ALLOY
ES, δ-TITANIUM OXIDE AND TITANIUM MONOXIDE.

ersson.

Kemi, Vol. 15, Paper 21, 247-52 (1960).

he relations between the structures of α-titanium (hexagonal
-packed), β-titanium (body-centred cubic), titanium monoxide
close-packed arrangement of the metal atoms), the ω-alloy
s and δ-titanium oxide are discussed.

539.2 : 548.7

311 THE CUBIC—HEXAGONAL TRANSFORMATION IN SINGLE CRYSTALS OF COBALT AND COBALT—
EL ALLOYS. P.Gaunt and J.W.Christian.

metallurgica, Vol. 7, No. 8, 529-33 (Aug., 1959).

Kinetic and crystallographic observations on the natural and
s-induced transformations have confirmed the martensitic
nature of the change. The shape deformation has been measured for the stress-induced transformation in alloys; the habit plane is not determined by a maximum resolved shear stress condition. The accommodation stresses produced by transformation have very marked effects, and thermal cycling eventually leads to stability of the cubic form down to liquid-air temperatures

539.2 : 548.7

16312 THE CRYSTALLOGRAPHY OF THE β—α TRANSFORMATION IN ZIRCONIUM AND IN TWO TITANIUM—MOLYBDENUM ALLOYS. P.Gaunt and J.W.Christian.

Acta metallurgica, Vol. 7, No. 8, 534-43 (Aug., 1959).

The habit planes and orientation relationships associated with the transformation have been studied in two specimens of crystal bar zirconium. The results are very similar to those of earlier workers for titanium, but the habit planes lie a little nearer to the $\{001\}$—$\{111\}$ boundary and the $\{11\bar{2}0\}_\alpha$ pole is displaced a little further from $\{11\bar{1}\}$ towards $\{1\bar{1}0\}$ than in titanium. The results are compared with the predictions of the Bowles—Mackenzie theory; as with titanium, best agreement is obtained with a type A (α^+,ω^+) solution, but in the present work it is not possible to obtain exact agreement for both orientations and habit planes. X-ray and kinetic observations both show that deformation accompanying transformation is much more severe in zirconium than in titanium, possibly as a result of a larger volume change, and the discrepancies may be due to the accommodation stresses. The habit planes and shape deformations have been determined for stress-induced martensite in quenched titanium alloys containing 11 per cent and 12.5 per cent molybdenum. In the 12.5 per cent alloy, only $\{344\}$ type martensite was produced by stress, but both $\{334\}$ and $\{344\}$ types were produced in the other alloy, with the $\{334\}$ predominating. The observed shear directions for the $\{334\}$ martensite agreed with the predictions of the type A (α^+,ω^+) solution. A tentative orientation relation was obtained for one plate of $\{344\}$ martensite; the present theory of this type of transformation is briefly discussed.

539.2 : 548.7 : 539.21

16313 ON THE THEORY OF MARTENSITIC TRANSFORMATIONS. THE GENERALIZED LATTICE INVARIANT SHEAR AND THE DEGENERACY OF SOLUTIONS FOR THE CUBIC TO TETRAGONAL TRANSFORMATION. M.S.Wechsler.

Acta metallurgica, Vol. 7, No. 12, 793-802 (Dec., 1959).

The theory of the crystallography of martensitic transformations is extended in terms of generalized elements for the lattice invariant shear. The degeneracy of solutions for the undistorted plane, the orientation relation, and the macroscopic change of shape is examined analytically for the cubic to tetragonal transformation. The criteria for K-degeneracy and g-degeneracy are developed and compared with those given by Christian as a result of a geometrical treatment. Existence conditions for real solutions are also developed in terms of the generalized theory.

539.2 : 548.7

16314 THE LATTICE SPACINGS AND THE STABILITY OF CLOSE-PACKED HEXAGONAL Cu—Ga, Cu—Ge AND Ag—Al ALLOYS. T.B.Massalski and B.Cockayne.

Acta metallurgica, Vol. 7, No. 12, 762-8 (Dec., 1959).

The lattice spacings of close-packed hexagonal ζ-phases in the systems Cu—Ge, Cu—Ga and Ag—Al have been determined as a function of composition and electron : atom ratio, using alloys quenched from 550°C. The results show that overlap of occupied states across the $\{10\bar{1}0\}$ faces of the Brillouin zone occurs at the electron : atom ratio of 1.415 in Cu—Ge alloys, 1.43 in Cu—Ga alloys and at 1.47 in Ag—Al alloys. In all three systems the relative distortion of the a lattice spacings due to overlap increases linearly at higher values of overlap at a rate of 3.5×10^{-3} A per 0.1 increase in the electron : atom ratio. In the system Ag—Al the change of slope in the c lattice spacings near the electron : atom value of 1.62 may be interpreted in terms of interaction of the Fermi surface with the $\{10\bar{1}0\}$ faces of the Brillouin zone before contact.

539.2 : 548.7

16315 LATTICE PARAMETERS AND ZONE OVERLAP IN SOLID SOLUTIONS OF LEAD IN MAGNESIUM.

C.B.Walker and M.Marezio.

Acta metallurgica, Vol. 7, No. 12, 769-73 (Dec., 1959).

Lattice parameters have been measured as a function of composition for solid solutions of lead in magnesium with a relative precision of 1 : 25 000. Both parameters vary smoothly with composition, with no sign of a break or rapid change in slope, and thus give no evidence of any onset of electron overlap across faces of the

Brillouin zone, contrary to the results of Raynor. Further consideration of the various lattice parameter data in the literature for five other dilute solid solutions in magnesium suggests that in none of these particular solid solutions do the lattice parameter data give satisfactory evidence of the onset of overlap.

539.2 : 548.7

16316 X-RAY STUDY OF THE KINETICS OF ORDERING IN AuCu.

J.L.O'Brien and G.C.Kuczynski.

Acta metallurgica, Vol. 7, No. 12, 803-6 (Dec., 1959).

The kinetics of the disorder-to-order transformation in AuCu has been studied by means of X-ray powder patterns. It has been found that the transformation occurs by the nucleation and growth of ordered domains in the disordered matrix. The degree of order in the newly formed domains is close to but less than the equilibrium value.

539.2 : 548.7 : 539.219

16317 ANOMALIES IN THE X-RAY THERMAL SCATTERING FACTOR FOR Ni—Cr, Cu—Zn, AND Ni—V ALLOYS.

A.S.Kagan and Ya.S.Umanskii.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 2, 326-8 (May 11, 1960). In Russian.

The alloys studied were Ni—21%Cr, Cu—31.6%Zn, and Ni—8% V. The Debye temperatures of the alloys were measured both by an X-ray method and from the elastic moduli. The values obtained by the two methods differed by ~ 20%. M.G.Priestley

539.2 : 548.7

16318 X-RAY INVESTIGATION OF THE γ-PHASE IN THE BISMUTH—PALLADIUM SYSTEM.

N.N.Zhuravlev.

Kristallografiya, Vol. 3, No. 4, 503-4 (1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3, No. 4, 506 (July-Sept., 1958).

It is shown that previous results claiming a compound Pd_5Bi_3 are incorrect. The high-temperature modification or γ-phase has a very extended solubility region and shows a superlattice formation of the nickel arsenide type. Below 400°C the material consists of mixed BiPd and $BiPd_3$. C.A.Hogarth

539.2 : 548.7

16319 CRYSTAL STRUCTURES OF THE HIGH-PRESSURE FORMS OF ICE: ICE III.

W.B.Kamb and S.K.Datta.

Nature (London), Vol. 187, 140-1 (July 9, 1960).

The structures of ice II and III were investigated by X-ray diffraction, both powder and single-crystal methods being used. The specimens were examined at −190°C, using Tamman's discovery that the high-pressure forms of ice may, once formed, be held metastably at atmospheric pressure if maintained at liquid nitrogen temperature. Details of the structure of ice III are given; they do not agree with those proposed by McFarlan (Abstr. 392-3 of 1936). J.Thewlis

539.2 : 548.7

16320 AN ELECTRON-DIFFRACTION INVESTIGATION OF THIN ALUMINIUM ANTIMONIDE LAYERS.

V.I.Ust'yanov and R.M.Khaikina.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 144-9 (1959). In Russian.

Thin layers of AlSb, prepared by vacuum sublimation on to glass plates at 850-900°C, had the same (sphalerite) structure as the massive samples. During the first stage of sublimation Sb was evolved, and AlSb layers were produced only after a lengthy preliminary run. A.Tybulewicz

539.2 : 548.7

16321 CRYSTAL STRUCTURE OF β-Ga_2O_3.

S.Geller.

J. chem. Phys., Vol. 33, No. 3, 676-84 (Sept., 1960).

The crystal structure of β-Ga_2O_3 was determined from single-crystal three-dimensional X-ray diffraction data. The monoclinic crystal has cell dimensions $a = 12.23 \pm 0.02$, $b = 3.04 \pm 0.01$, $c = 5.80 \pm 0.01$ A and $\beta = 103.7 \pm 0.3°$ as originally reported by Kohn, Katz, and Broder [American Mineralogist, Vol. 42, 398 (1959)]. There are 4 Ga_2O_3 in the unit cell. The most probable space group is $C^3_{2h}—C2/m$; the atoms are in five sets of special positions 4i: $(000, \frac{1}{2}\frac{1}{2}0) \pm (x0z)$. There are two kinds of coordination for Ga^{3+} ions in this structure, namely tetrahedral and octahedral. Average interionic distances are: tetrahedral Ga—O, 1.83 A; octahedral Ga—O, 2.00 A; tetrahedron edge O—O, 3.02 A; and octahedron edge O—O 2.84 A. Because of the reduced coordination of the half of the metal ions, the density of β-Ga_2O_3 is lower than that of α-Ga_2O_3 which has the α-corundum structure. Also the closest approach of two G ions in β-Ga_2O_3 is 3.04 A which is considerably larger than the closest approach of metal ions in the sesquioxides with the α-c dum-type structure and, in agreement with the results of therm dynamic measurements, the β phase appears to be the structu more stable one. The average Ga—O distances in the structure to account for the fact that although the Ga^{3+} ion is substantiall larger than the Al^{3+} ion its quantitative preference for tetrahed coordinated sites when substituted for Fe^{3+} ion in the iron garn very nearly the same as that of the Al^{3+} ion. The structure acc for a recent result obtained by Peter and Schawlow from param netic resonance measurements on Cr^{3+}-ion-doped β-Ga_2O_3 nam that the Cr^{3+} ion substitutes for the Ga^{3+} ions in a single set of equivalent octahedral sites. The magnetic aspects of the β-Ga_2 structure are discussed and it is shown that a possible Fe_2O_3 is morph could be expected to be at least antiferromagnetic with a Néel temperature of about 700°K. Furthermore, a knowledge of β-Ga_2O_3 structure and of the nature of site preferences of the G and Fe^{3+} ions in the garnets lead to a prediction regarding the structure of the ferrimagnetic crystals of formula $Ga_{2-x}Fe_xO_3$ recently discovered by Remeika.

539.2 :

16322 INTERATOMIC DISTANCES IN FeS_2, CoS_2, AND Ni

N.Elliott.

J. chem. Phys., Vol. 33, No. 3, 903-5 (Sept., 1960).

The sulphur—sulphur distances obtained from X-ray powde photographs were found to vary, depending on the number of ant bonding electrons shared with the metal ions.

539.2 :

16323 ON THE DIFFUSE X-RAY SCATTERING OF KCl—K SOLID SOLUTION.

M.Kantola and P.Luova.

Ann. Acad. Sci. Fennicae A VI, No. 49, 15 pp. (1960).

The diffuse scattering from KCl, KBr and solid solution KCl—KBr was studied by a photographic method. To compare t results with the predictions of Faxén-Waller theory, some shap of isodiffusion surfaces are recalculated, and they are found to slightly different from figures found in the literature. The max of diffuse spots observed in Laue pictures are positioned in the reciprocal lattice. A general accordance with the theory is foun A slight difference in the diffuse scattering is found between the mixed crystal and its components, so that with small deviation angles (below 30') the separation of the diffuse spot from the La spot is unsymmetrical in the KCl—KBr $\bar{2}20$ case, while in all ot cases it is symmetrical. With all crystals there is found a rela strong extra line between Laue and diffuse spots, that cannot be explained simply as the sum of both spots when slightly apart fr each other. A method of finding the right position of the crystal found that is faster and more accurate than the old one. It is impossible to examine the anomalies more accurately by the ph graphic method.

539.2 : 5

16324 TERNARY CARBIDES OF THE TRANSITION META NICKEL, COBALT, IRON, MANGANESE WITH ZINC AND TIN.

H.H.Stadelmaier and L.J.Huetter.

Acta metallurgica, Vol. 7, No. 6, 415-19 (June, 1959).

In the ternary systems Co—Sn—C, Fe—Sn—C, Ni—Zn—C, Co—Zn—C and Fe—Zn—C double carbides were found that corre pond to the formula T_3BC_x. where T is the transition metal. The compounds have an ordered face-centred cubic structure and together with the known compounds Mn_3SnC and Mn_3ZnC belong to the group of carbides reported previously by the authors.

539.2 : 5

16325 MORPHOLOGY AND CRYSTAL STRUCTURE OF CARBIDES PRECIPITATED FROM SOLID SOLUTIO ALPHA IRON.

W.C.Leslie, R.M.Fisher and N.Sen.

Acta metallurgica, Vol. 7, No. 9, 632-44 (Sept., 1959).

The carbides precipitated from solid solution in high-purity iron—carbon alloys, in two low-carbon steels and in an iron—ca 3.25% silicon alloy were studied by electron microscopy and diff tion. In the iron—carbon alloy and in the two low-carbon steels carbide precipitates in a dendritic form during aging following quenching. In specimens quenched directly to the aging tempera oblong plates appeared, along with dendrites. Both of these form are cementite (Fe_3C) and no diffraction evidence of precipitation epsilon carbide was found. The time required for formation of identifiable particles at 250°C corresponds to the time reported others for 70% completion of the precipitation reaction, as meas ternal friction. At 150°C the time required for formation of particles was much longer than the time for completion of ipitation, as measured by internal friction. The dendritic ides in Fe–C alloys appear to precipitate on {110} planes of te, with branches along ⟨111⟩ directions. In the iron–3.25% on alloy the carbides take the form of lenticular disks precipitated 00} planes of the ferrite matrix; the crystal structure of this ide was not determined but it is neither epsilon nor cementite. disks are displaced by grain boundary films of cementite during onged aging.

539.2 : 548.7

6326 APPLICATION OF THE CoK_{α} RADIATION IN AN X-RAY INVESTIGATION OF THE CONSTITUTION Ni–Zn FERRITES.

V.V.Latsh, N.G.Minaev and B.Kh.Somin.

tverdogo Tela, Vol. 2, No. 7, 1632-42 (July, 1960). In Russian.

To overcome the difficulties, encountered in applying Fe radi- n in X-ray analysis of Ni–Zn ferrites, CoK_{α} radiation was loyed in the present investigation which entailed also chemical metallographic analyses. It was revealed that no solid solu- of ZnO in NiO is formed during ferritization of mixtures of chiometric composition, the process of the formation of the and Ni-ferrites being completed at 900 and 1100°C, respec- ly. When ferrite mixtures, deficient in iron oxide, are fired ve 900°C, an exchange reaction takes place between the excess and Zn-ferrite as a result of which the relative proportion of divalent Ni and Zn ions in the ferrite lattice changes. On her heating, NiO and ZnO form a substitutional solid solution the NiO crystal lattice, the parameter of which increases with easing ZnO content. The solid solubility limits of ZnO in NiO 300 and 900°C are 50 and 30 wt%, respectively. In the case of Zn ferrites, containing less than 50 mole% Fe_2O_3, the excess and NiO form a solid solution, but only after the process of itization of Zn has been completed. M.H.Sloboda

539.2 : 548.7

6327 THE STRUCTURE OF ZnSb–CdSb ALLOYS.

K.Toman.

hys. Chem. Solids, Vol. 11, No. 3-4, 342 (Oct., 1959).

X-ray powder photographs indicated complete solid solubility nSb with CdSb, with continuous variation of lattice parameter composition. This contradicts the postulated existence of a pound $ZnCdSb_2$ (see Abstr. 7962 of 1958). A.R.Stokes

539.2 : 548.7

16328 ON THE STRUCTURE OF CAESIUM HEXAHALOGENO-PLUMBATES (II).

C.K.Moller.

Danske Vidensk. Selsk, mat.-fys. Medd., Vol. 32, No. 3, 13 pp. 60).

Crystalline compounds of composition Cs_4PbX_6, in which = Cl, Br, or I may be prepared either from aqueous solutions by fusing CsX and PbX_2 together. X-ray investigations show t the crystals are rhombohedral and belong to space group 167 R$\bar{3}$c. The hexagonal unit cells have dimensions a = 13.18_7 A, = 16.64_1 A for Cs_4PbCl_6; a = 13.73_2 A, c = 17.32_4 A for Cs_4PbBr_6; = 14.52_8 A, c = 18.31_3 A for Cs_4PbI_6, and contain six olecules". The molar volumes of Cs_4PbX_6 are larger than sum of the molar volumes of CsX and PbX_2 by about 6 cm³ per m-atom halogen. Atomic parameters can be obtained from rly well resolved Patterson and electron-projections on (1$\bar{2}$10). e Pb and X atoms form isolated, slightly distorted PbX_6-octa- lra; the PbCl distances are 2.93 A and the PbBr distances are 2 A, i.e. in both cases a little longer than in the $CsPbX_3$ npound, but shorter than the sum of the ionic radii. The agree- nt between calculated and observed structure factors is not so d as wanted. This may in part be due to a small delocalization und their average positions of the Cs atoms having an irregular coordination.

539.2 : 548.7

16329 LEAD SELENATE CRYSTALS.

Ya.Sauka and S.Apinit.

stallografiya, Vol. 4, No. 2, 262 (March-April, 1959). In Russian. glish translation in: Soviet Physics–Crystallography (New York), . 4, No. 2, 242-3 (Feb., 1960).

A note quoting results of goniometric and X-ray diffraction asurements on single crystals grown by slow precipitation. D.G.Holloway

539.2 : 548.7

16330 ELECTRON-DIFFRACTION STUDY OF THE STRUCTURE OF THIN FILMS OF $TlBiSe_2$ AND $TlSbS_2$.

S.A.Semiletov and L.I.Man.

Kristallografiya, Vol. 4, No. 3, 414-17 (May-June, 1959). In Russian. English translation in: Soviet Physics–Crystallography (New York), Vol. 4, No. 3, 385-8 (March, 1960).

Vacuum-evaporated layers, deposited on rocksalt or on celluloid film, were used. Detailed structural results are given and it is shown that a range of ternary compounds of these types exist and possess a rocksalt structure. C.A.Hogarth

539.2 : 548.7

16331 DETERMINATION OF THE UNIT CELL DIMENSIONS AND SPACE GROUP OF THE $\frac{1}{3}$ HYDRATE OF POTASIUM THIOSULPHATE $K_2S_2O_3.\frac{1}{3}H_2O$.

L.Chordash and D.Mentsel'.

Kristallografiya, Vol. 3, No. 3, 372-3(1958). In Russian. English translation in: Soviet Physics – Crystallography (New York), Vol. 3, No. 3, 373-4 (May-June, 1958).

From oscillation and zero layer-line Weissenburg photographs the unit cell dimensions were found to be: a = 9.389, b = 6.00, c = 30.98 A, β = 98°22'. From non-zero equi-inclination Weissenburg photographs the space group was determined as $P2_1/c$. The measured density was 2.262 g/cm³, and the X-ray density 2.267 g/cm³ for 12 formula units per unit cell. A complete structural analysis is planned. Powder photographs were taken with a 114.7 mm diameter camera, and they contain lines not given on the A.S.T.M. card. R.V.Coates

539.2 : 548.7 : 537.2

X-RAY DIFFRACTION STUDIES OF THE $BaTiO_3$–$BaSnO_3$ SYSTEM. See Abstr. 16017

539.2 : 548.7 : 537.2

STRUCTURE OF THE $BaTiO_3$–$BaZrO_3$, $BaTiO_3$–$BaSnO_3$, $BaTiO_3$–ZrO_2 AND $BaTiO_3$–SnO_2 SYSTEMS. See Abstr. 16618

539.2 : 548.7

16332 CRYSTAL STRUCTURE OF 1.2-CYCLO-PENTENOPHENANTHRENE.

B.S.Basak and M.G.Basak.

Indian J. Phys., Vol. 33, No. 3, 107-10 (March, 1959).

The crystal structure was determined by the Fourier synthesis method. A qualitative suggestion about the structure was made by Iball (1935). The crystal data are; molecular formula $C_{17}H_{14}$; monoclinic system: a = 18.38 A; b = 5.83 A; c = 23.61 A; β = 114°-18'; space-group $B2_1/c$ (real space-group $P2_1/c$-C^5_{2h}): density = 1.23 gm/cm³ at 20°C; number of molecules per unit cell ("b" face-centred cell) = 8.0.

539.2 : 548.7

16333 OBSERVATIONS ON SINGLE CRYSTALS OF AN ISOTACTIC POLYOLEFIN: MORPHOLOGY AND CHAIN PACKING IN POLY-4-METHYL-PENTENE-1.

F.C.Frank, A.Keller and A.O'Connor.

Phil. Mag. (Eighth Ser.), Vol. 4, 200-14 (Feb., 1959).

Single crystals of isotactic poly-4-methyl-pentene-1 were prepared from solution. The crystals were mostly flat squares with more or less regular shapes. They consisted of thin square layers forming spiral terraces centred on screw dislocations. The molecules were found to be perpendicular to these layers. The same polymer could also be obtained in the form of thin fibrils with the molecules perpendicular to the fibril direction. Both these habits require chain folding, further implications of which are discussed. The unit cell was determined and was found to be tetragonal with a = b = 18.66 A and c = 13.80 A containing four chains. The packing of these chains closely approximates a two-dimensional rock-salt type arrangement with one chain surrounded by four nearest neighbours. It is shown that the helical chains can be in gear with this type of packing, engaging most perfectly if half and half are of opposite winding direction.

VARIOUS SOLID STRUCTURES

539.21

16334 DIRECT DETERMINATION OF THE TRANSITION ENERGIES OF NH_4Cl AT 183.1°C AND NH_4Br AT 137.2°C. A.Arell.

Ann. Acad. Sci. Fennicae A VI, No. 57, 42 pp. (1960).

A new differential calorimetric method is described for the determination of the transition energies between different modifications of solids. A suitable apparatus was constructed and a mathematical treatment for the calculation of the results given. The measuring accuracy of the differential calorimeter was investigated, both by using an experimental calibration and by examining the effect of various error sources on the transition energy to be measured. A measuring accuracy of $\sim 2\%$ was found for the transition energies of $\sim$ 100-200 calories. The inaccuracy of the transition temperature also has an effect to the final results. The measuring method was discussed in detail. It was shown that the values obtained for the transition energies cannot be too great. The transition energies of NH_4Cl at 183.1°C and NH_4Br at 137.2°C were measured. The results were 1073 cal/mole for NH_4Cl and 882 cal/mole for NH_4Br. Correspondingly, $1\frac{1}{2}\%$ and 3% were estimated for the measuring accuracies. It was stated that the present direct method gives somewhat greater values to the transition energies that the previous indirect ones. In the case of NH_4Cl, however, the measured transition energy is in good agreement with the value of Scheffer (1915).

539.21

16335 DILATOMETRIC INVESTIGATION OF NH_4Cl AT 183.1°C AND NH_4Br AT 137.2°C. J.Pöyhönen.

Ann. Acad. Sci. Fennicae A VI, No. 58, 50 pp. (1960).

A dilatometer has been constructed for the investigation of the transitions $I \rightleftharpoons II$ of NH_4Cl and NH_4Br. By using this apparatus it was possible to determine values for the total volume changes at these transitions within an accuracy of 0.09%. The temperature variation of the thermostat of the dilatometer was ±0.007°C at the measuring temperatures. In addition, the course of the above transitions as a function of time was investigated at various temperatures. A method for the determination of the transition temperature by means of the transition rate was presented. For NH_4Cl and NH_4Br the values of 183.1°C and 137.2°C were obtained for the transition temperatures. These results are somewhat lower than the previous ones. On the other hand, the values of the total volume changes measured in the present work, 0.1315 cm^3/g for NH_4Cl and 0.0795 cm^3/g for NH_4Br, are considerably higher than those determined by Bridgman (1916). The pressure derivatives of the transition temperatures were calculated from the Clausius—Clapeyron equation by using the results obtained and the values of the transition energies determined by Arell (see preceding abstract). Because the values of these derivatives agree well with those of Bridgman, the Clausius—Clapeyron equation seems to be strictly valid for these transitions. Furthermore, the normal behaviour of the thermal expansion of the different modifications near the transition temperatures confirms the hypothesis that the transitions investigated belong to the group of first order phase transformations. In addition, overheating and undercooling of preparations were observed. The relaxation temperatures of overheating and undercooling were shown to move upwards with increasing crystal size.

539.21

16336 THEORY OF ORDER IN TERNARY ALLOYS. II. K.F.Wojciechowski.

Acta metallurgica, Vol. 7, No. 6, 376-9 (June, 1959).

For Pt I, see Abstr. 6436 of 1958. A statistical theory of the order—disorder transformations for ternary alloys of arbitrary composition and crystal structure is given. Long-range and short-range order parameters are defined, and equations connecting these parameters are given. The general formula for configurational free energy is deduced and the method of calculation of the order—disorder transition temperature is shown. As examples the Heusler alloys Cu_2MnAl and $Cu_2(MnAl)$ and the alloys Ag-Mg-Sn are considered.

539.21

16337 EFFECT OF APPLIED TENSILE STRESS ON PHASE TRANSFORMATIONS IN STEEL.

L.F.Porter and P.C.Rosenthal.

Acta metallurgica, Vol. 7, No. 7, 504-14 (July, 1959).

Using a specially designed apparatus capable of making simultaneous measurements of the electrical resistance and the exte
of a wire specimen during rapid quenching or isothermal transf
tion, the transformation characteristics of a eutectoid steel hav
been studied under dead-weight tensile loading. Data obtained
transformation to pearlite, bainite, and martensite indicate that
there is a threshold stress above which transformation is accel
ated. When transforming under load, extensive plastic deforma
is noted coincident with transformation. There also appears to
a threshold stress associated with the plastic deformation. In t
case of transformation to pearlite and bainite, increased rates
transformation occur at the same threshold stress as the plast
deformation. On transformation to martensite gross plastic def
ation occurs at very low stress, while the M_S temperature is no
raised until stresses on the order of 28 500 lb/in^2 are reached.
account for the coincidence of transformation and plastic extens
is proposed that dislocations piled up at grain boundaries and ot
barriers produce stress fields which result in increased rates c
nucleation. Moreover, when the nucleus loses coherency with th
parent austenite, the advancing interface acts as a sink for the p
up dislocations and thus plastic deformation is observed. Accor
to this picture, the threshold stress is the stress necessary to r
free dislocations out from their sources to produce the piled-up
arrays. The difference in the behaviour of the martensite trans
formation under load can be explained on the basis of the differe
between the mechanism of formation of martensite and that of pearlite and bainite.

5

16338 CELL TO DENDRITE TRANSITION IN TIN BASE ALLOYS. T.S.Plaskett and W.C.Winegard.

Canad. J. Phys., Vol. 38, No. 8, 1077-88 (Aug., 1960).

The transition from cellular growth to dendritic growth was
investigated for dilute binary alloys of zone-refined tin with lea
bismuth, and antimony in terms of the rate of growth R, the tem
perature gradient in the liquid ahead of the solid—liquid interfa
G, and the solute concentration C_0. It was found that a previous
relationship describing the transition for lead base alloys appli
at least to a first approximation, for the low solute concentratio
tin results. At the high concentrations of solute, however, it wa
necessary to introduce another variable, namely the cell size at
transition d_t. The transition relationships only applied for allo
systems with a distribution coefficient k_0, less than unity. For
systems with $k_0 > 1$ (antimony in tin) a $k_0 < 1$ was used which w
equivalent to the $k_0 > 1$. A method is described for determining
this "equivalent k_0".

539.21 : 539.2 :

THE THEORY OF THE MARTENSITIC TRANSFORMATION THE CUBIC TO TETRAGONAL TRANSFORMATION. See Abstr. 16313

539

16339 SURFACE STRUCTURE AND INTERNAL STRUCTU OF GLASS. M.Navez and C.Sella.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4325-7 (June 27, 1960

In French.

A granular structure of dimensions between 50 and 300 A is
shown to exist in freshly fractured surfaces of certain commerc
glasses. The surfaces were studied in the electron microscope
using replicas shadowed with platinum—carbon—iridium. The
polished surface of the glass does not show the effect.

A.E.I. Research Labora

539

16340 CRYSTALLINITY EFFECTS IN THE ELECTRON MIC SCOPY OF POLYETHYLENE.

A.W.Agar, F.C.Frank and A.Keller.

Phil. Mag. (Eighth Ser.), Vol. 4, 32-55 (Jan., 1959).

Single crystals of polyethylene were examined electron-microscopically with special precautions to avoid damage due to
the electron beam. A variety of unexpected beam-sensitive feat
were observed. They can be classified as (1) moirés, (2) morph
logical features. In connection with (1) the general principles of
moirés are discussed. It is shown that moirés can be due eithe
double diffraction, the conditions of the formation of which are
defined, or to dislocations arising through contact deformation o
superimposed crystals. Observations on polyethylene crystals a
analysed in the light of this general discussion. It is found that
moirés are to a large extent due to rotational superposition of la
In places the moiré makes a pseudo-image of the crystal lattice
self, in others only of particular lattice planes. There is eviden

trong local lattice distortions, and also for possible local de- res from orthorhombic symmetry. Various other features are discussed and fundamental difficulties in the interpretation of e contrast are pointed out. (2) A surface corrugation strongly tened by extinction effects was found, which disappeared within rt time after the preparation of the specimens. This was tively interpreted as resulting from a change in the molecular ength, when the crystals are dried down. The corresponding tions did not follow the index crystallographic directions. e is evidence for the existence of distinguishable quadrants n the crystals, and also of internal buckling, both of which are stent with other considerations. Repeated asymmetric twinning (010) and to a lesser extent along (100) was observed, which ccount for a variety of observed crystal shapes.

539.214 : 539.2 : 538.27

PARAMAGNETIC-RESONANCE STUDIES OF IRRADIATED -DENSITY POLYETHYLENE. See Abstr. 16176

539.215

6341 A METHOD FOR THE ROUTINE MEASUREMENT OF PARTICLE SHAPE FACTORS IN THE SIEVE RANGE.

Harris; D.Howitt.

re (London), Vol. 187, 401-3, 403 (July 30, 1960).

A variation of the volume factor K in the equation $V = kd^3$ of samples is demonstrated by plotting V/d^3 as a function of d, nean particle size in μ. The employed technique becomes diffi- with meshes finer than about 100 B.S. There is an appendix method of making standard aperture count meshes.

R.Schnurmann

539.219

6342 LATTICE PARAMETER AND RESISTIVITY STUDY OF ORDER IN THE ALLOY $CuAu_3$. P.Wright and K.F.Goddard.

metallurgica, Vol. 7, No. 12, 757-61 (Dec., 1959).

Observed changes in lattice parameter and resistivity with ree of order indicate $T_C \cong 190^\circ C$ for the alloy $CuAu_3$; from ley's theory of order this yields $V_1 = 269k$, $V_2 = -26.9k$, 0, for the ordering interaction energies of pairs of atoms separ- by the three shortest distances. The possibility of a linear tionship between lattice parameter and short-range order para- er or configurational energy is examined.

539.219

6343 THE HEATS OF FORMATION OF SOLID NICKEL—COPPER AND NICKEL—GOLD ALLOYS.

.Oriani and W.K.Murphy.

a metallurgica, Vol. 8, No. 1, 23-5 (Jan., 1960).

The enthalpies of formation at 640° C of these alloys were sured as a function of composition by means of a differential tion calorimeter. Both systems are characterized by positive s of formation. The concentration variations of the partial ar heats of solution of Cu and of Ni in liquid Sn at 640° C were lored. It is shown that Cu in Sn does not satisfy the require- ts of the quasi-chemical theory, whereas Ni in Sn does so in experimental uncertainty.

539.219

16344 GRAIN-BOUNDARY ENERGIES IN GOLD—COPPER ALLOYS. J.E.Hilliard, M.Cohen and B.L.Averbach.

a metallurgica, Vol. 8, No. 1, 26-31 (Jan., 1960).

The ratio of grain-boundary to surface energy was determined a function of composition. From interferometric measurements he boundary groove angles in specimens thermally etched at °C, the following average grain-boundary to surface-energy os were obtained: 0.25, 0.28, 0.34, 0.42, 0.37 and 0.36 at 0, 20, 60, 80 and 100 at.% respectively. Existing data for the surface rgies yield 370, 320, 310, 390, 430 and 590 erg cm^{-2}, respectively the absolute grain-boundary energies. A calculation is included he boundary adsorption corresponding to this energy variation, an estimate is made of the minimum number of atoms required he grain boundary to accommodate the calculated absorption.

539.219

16345 THE CONTRIBUTION OF ATMOSPHERE LOCKING TO THE STRAIN-AGEING OF LOW CARBON STEELS.

.Wilson and B.Russell.

a metallurgica, Vol. 8, No. 1, 36-45 (Jan., 1960).

Cottrell locking of dislocations and precipitation hardening can contribute to the increase in the lower yield stress which elops during the strain-ageing of low carbon steels. An analysis tress—strain relationships based on the Petch equation, $\sigma_y = \sigma_i + k_y d^{-1/2}$, allows a separation of the contributions of these two sources of hardening. Observations of the development of changes in the tensile stress—strain relationship during ageing have shown that atmosphere locking develops first, causing an increase in $k_y d^{-1/2}$ with little change in σ_i. An estimation based on the Cottrell—Bilby equation suggests that this first stage is completed when the dislocation atmosphere density reaches a value between one and two atoms per atom plane. After completion of the first stage, further segregation of solute has little or no effect on dislocation pinning; the increases in yield stress are then due to increases in σ_i and must be caused by solute cluster formation or precipitation. In a strain-aged steel, the contribution of atmosphere locking to the lower yield stress is rather small compared with that in an annealed steel of the same grain size. This may be a consequence of the finer scale of the dislocation network in the cold worked material.

539.219

16346 ENTROPY OF LONG RANGE ORDER IN Cu_3Au AND Ni_3Fe. V.Hovi and K.Mansikka.

Acta metallurgica, Vol. 8, No. 1, 53-4 (Jan., 1960).

This has been calculated for Cu_3Au between 250° and 380° C and Ni_3Fe between 115° and 525° C using the combinatory number and experimental specific heat curves. Both the theoretical and experimental values of the long range order parameter for Cu_3Au have been used, but only the theoretical one for Ni_3Fe. In all cases the entropy values based on the combinatory number are smaller than those obtained from the specific heat data; nevertheless the agreement is good. It is concluded that the combinatory number gives a good approximation for the entropy of long-range order for the systems considered.

A.E.Kay

539.219

16347 KINETICS OF CLUSTERING IN SOME ALUMINUM ALLOYS. D.Turnbull, H.S.Rosenbaum and H.N.Treaftis.

Acta metallurgica, Vol. 8, No. 5, 277-95 (May, 1960).

The kinetics of clustering of the solute in the aluminium rich alloys Al(Cu), Al(Ag) and Al(Zn) was investigated by means of resistivity measurements. In each of the alloys there is, after a rapid quench from the homogenization temperature, a fast initial clustering at temperatures 200°-300° K. This reaction proceeds with an activation energy 0.5-0.6 eV in Al(Cu) and Al(Ag), and 0.4 eV in Al(Zn). In Al(Cu) and Al(Ag) the isothermal progress of the reaction is, to a first approximation, independent of solute concentration. The forms of the isotherms are interpreted on the hypothesis that from the atomically dispersed state the reaction corresponds to the surface energy driven growth of large clusters at the expense of smaller ones. The growth rate, the total progress of the reaction, and their marked variation with thermal history, are satisfactorily interpreted with the quenched-in vacancy hypothesis if it is supposed, in addition that sensible nucleation of dislocation loops occurs at very high vacancy supersaturations. Evidence is presented that the limiting cluster size is dictated by kinetic rather than by thermodynamic factors. It was found that in very dilute Al(Ag) the isothermal resistivity, as in the case of Al(Zn) and Al(Cu), rises with time in the earliest stages of clustering. After the rapid initial clustering there is a further slow reaction in Al(Cu) alloys which occurs over a period of several weeks. This rate is still much greater than that calculated from the extrapolated values of the high temperature diffusion constant of Cu in Al. Some possible interpretations of this slow reaction are outlined.

539.219

16348 LONG-RANGE ORDER IN Fe RICH Fe—Al ALLOYS. I. A ZEROTH APPROXIMATION CALCULATION OF ORDER WITH APPLICATION TO THE PHASE DIAGRAM.

P.S.Rudman.

Acta metallurgica, Vol. 8, No. 5, 321-7 (May, 1960).

It is shown that a quasi-chemical description of long-range order in these alloys requires two independent order parameters and at least second neighbour bonding. Using the zeroth approximation the defining equations for order are obtained. The transformation temperature consequences of the calculation are employed in evaluating experimental data and a revised version of the Fe—Al phase diagram is arrived at. It is shown that for compositions greater than 25 at.% Al the onset of Fe_3Al type order is well approximated by the independent ordering of a simple cubic lattice to a NaCl structure but at an effective composition depending on the perfection of the FeAl type order. From the experimental values of the transition temperatures at the composition Fe_3Al it is calculated that the ratio of the second to the first neighbour interchange energies is about one half.

539.219

16349 THE STORED ENERGY OF COLD WORK AND ITS RELATION TO WORK SOFTENING.

A.L.Titchener and M.B.Bever.
Acta metallurgica, Vol. 8, No. 5, 338-42 (May, 1960).

One set of wires of an 82.6 Au—17.4 Ag (wt %) alloy was drawn at -195°C to a true strain of 0.62. A second set, after drawing at -195°C to a strain of 0.62, brought to room temperature and drawn to total strains of 0.85 and 1.08. The energy stored by these wires was measured by tin-solution calorimetry. Annealing at room temperature reduced the stored energy from 90 to 51 cal/gram atom. Working at room temperature caused a further reduction to approximately 30 cal/gram atom. This release of stored energy induced by cold work is closely related to the phenomenon of work softening. Hardness measurements confirmed that the gold—silver wires underwent work softening. The results are discussed in relation to the imperfections likely to account for the changes in stored energy and hardness.

539.219

16350 METALLOGRAPHIC INVESTIGATION OF PRECIPITATION OF SILICON FROM ALUMINUM.

H.S.Rosenbaum and D.Turnbull.
Acta metallurgica, Vol. 7, No. 10, 664-74 (Oct., 1959).

The precipitation of silicon (diamond cubic) from a supersaturated Al (1% Si) solid solution (f.c.c.) was studied qualitatively by X-ray diffraction and by both light and electron microscopy. This precipitation has the following metallographic features: (1) the precipitated silicon occurs as both plate-like and equi-axed particles; (2) near grain boundaries there exists a region depleted of precipitate particles. The width of the depleted region increases with slower rates of cooling from homogenizing temperature (580°C) prior to ageing; (3) in specimens that have been water-quenched and then cold worked prior to ageing, the precipitate particles are larger and more widely spaced inside slip bands than in unstrained regions. In specimens that have been more slowly cooled from the homogenizing temperature, the effect of cold work prior to ageing is to cause nucleation close to grain boundaries, but precipitation along slip bands was not found; (4) in single crystal specimens that were water-quenched from the homogenizing temperature and then aged, the precipitated silicon exhibited strong orientation preferences in the X-ray patterns. However, no exact, or Widmanstätten, orientation relation was found. The orientation preferences diminished as over-ageing occurred, and were not found at all in specimens that had been air-cooled instead of water-quenched. The results are shown to be consistent with the hypothesis that in the quenched alloy precipitation occurs on dislocation loops that result from the coalescence of quenched-in vacancies.

539.219

16351 SOLUBILITY OF SILVER AND IRON IN GERMANIUM ALLOYED WITH ANTIMONY AND PHOSPHORUS.

V.D.Ignatkov and V.E.Kosenko.
Fiz. tverdogo Tela, Sbornik [Supplement] II, 47-9 (1959). In Russian.

Between 650° and 850°C the solubilities of silver and iron in germanium, containing antimony and phosphorus in amounts from 10^{13} to 10^{18} cm^{-3}, were independent of the antimony and phosphorus content. In the same range of temperatures the solubility of silver in germanium was independent of the amount of iron introduced earlier. A.Tybulewicz

539.219

16352 SPARK-DISCHARGE-INDUCED STRUCTURAL CHANGES IN PLATINUM—SILVER ALLOYS.

A.A.Levchenko, V.A.Mityushov, A.P.Adakhovskii and L.S.Palatnik.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 3-9 (1960). In Russian.

The effect of spark discharges of 120 sec duration on the structure of Pt—Ag alloys, containing 10-90% Ag, was studied by X-ray diffraction. Owing to selective volatilization of Ag, its content in the surface layers of the electrodes decreased by 10-35%. Localized quenching of the electrode material led to the formation of metastable, supersaturated α-solid solution (with the maximum Pt content of up to 80%) and unsaturated δ-solid solution, containing 4.0 instead of 4.5% Ag. A disorder—order transformation, attributed to localized ageing of the α-solid solution occurred in alloys with 70-80% Ag. M.H.Sloboda

539.219

16353 CHARACTERISTICS OF THE INITIAL STAGES OF DECOMPOSITION OF A SUPERSATURATED SOLID SOLUTION OF TITANIUM IN COPPER.

E.G.Nesterenko and K.V.Chuistov.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 140-7 (1960).
In Russian.

X-ray diffraction analysis of a 4.5% Ti—Cu alloy, solution treated and aged at various temperatures showed that the initial stages of ageing of this alloy are characterized by the formatio of "modulated" structure, consisting of the solid solution matri with periodically spaced, Ti-enriched regions. The modulation period depended on the ageing time and temperature and varied between 80 and 160 A. Using a sinusoidal model, the authors calculated the parameters of a "modulated" crystal and showed tha the composition of the Ti-enriched regions was near to that of t stable Cu_3Ti phase. M.H.Slo

539

16354 DETECTION OF THE FORMATION OF CHEMICAL COMPOUNDS IN BINARY ALLOYS USING THE RESISTANCE-WELDING METHOD. L.N.Érastov.

Fiz. tverdogo Tela, Vol. 2, No. 2, 277-9 (Feb., 1960). In Russia

The high resistances of the welded contacts of Sb—Mg, Sb— Sb—Te, Sb—Cd, Sb—Ni, Mg—Te, Mg—Bi, Mg—Pb, Mg—Sn, Te— Te—Pd pairs showed that intermetallic compounds were formed the contact region. A.Tybule

53

16355 DETECTION OF ORDER IN Ni_3Co.

Y.L.Yao.
J. chem. Phys., Vol. 33, No. 3, 741-3 (Sept., 1960).

Measurements of the variation of oxidation rate of nickel— alloys with composition and of the variation of saturation magne ization and thermal e.m.f. of Ni_3Co with temperature show that Ni_3Co has a tendency to order at low temperatures. The critica temperature of ordering is shown to be 773 ± 1°C.

53

16356 ENTRY OF THALLIUM INTO THE LATTICE OF SODIUM IODIDE.

M.G.Buravleva, Ya.A.Zakharin and V.I.Startsev.
Kristallografiya, Vol. 4, No. 5, 773-4 (Sept.-Oct., 1959). In Rus
English translation in: Soviet Physics-Crystallography (New Y
Vol. 4, No. 5, 728-9 (May, 1960).

Estimates the solubility of TlI in NaI (as 2.62 mol. %) from measurements of the lattice parameter of doped NaI crystals as function of Tl concentration. D.G.Hollo

539

16357 THE KINETICS OF THE GROWTH OF PRECIPITAT FROM SOLID SOLUTIONS. J.Burke.

Phil. Mag. (Eighth Ser.), Vol. 5, 176-85 (Feb., 1960).

Equations are derived for the rate of precipitation from an initially homogeneous solid solution on the assumptions that the process involves growth of existing nuclei and that the rate of growth is controlled by diffusion. Various forms of precipitate are considered. Impingement of the zones of the parent solution depleted in solute is allowed for by multiplying the diffusion pote tial by (1—y) where y is the fraction of the total precipitation wh has occurred. The results are appreciably different from the eq tions currently used to analyse kinetic data.

539.219 : 538.27 :

NUCLEAR MAGNETIC RESONANCE IN ALKALI ALLOY SYSTEMS NaK AND NaRb. See Abstr. 14665

539.219 : 5

TITANIUM-BASE ALLOYS. See Abstr. 15800

539.219 : 539.2 : 5

EFFECT OF COLD WORK ON THE ELECTRICAL RESISTI OF COPPER SOLID SOLUTION ALLOYS. See Abstr. 15888

539.219 : 539.2 : 5

ANOMALIES IN THE X-RAY THERMAL SCATTERING FACTOR FOR Ni—Cr, Cu—ZN, AND Ni—V ALLOYS.

539.219 :

PHASE TRANSFORMATIONS AND PLASTIC DEFORMATIO OF Zn—Al ALLOYS. See Abstr. 16230

53

16358 ELECTRON DIFFRACTION FROM THIN FILMS OF COBALT OBTAINED BY THERMAL EVAPORATIO

F.Savornin.
C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 57-8 (July 4, 1960). In French.

Cobalt films of 50 to 225 A thickness were produced by eva ration at a pressure of 10^{-6} mm Hg on supports of collodion and

. They were examined by electron diffraction, either trans-on or reflection. If the evaporation is carried out with the rt at room temperature no diffraction rings were observed. support is at 190°C films of 50 and 225 A thickness show onal structure and the crystallinity is increased by subse- annealing at that temperature. Films prepared with the rt at 190°C and then annealed at 275°C show a diffraction rn characteristic of a face-centred cubic lattice. If the sup-s held at 275°C during evaporation both hexagonal and cubic ction patterns are obtained. J.Iball

539.23

359 PRODUCTION OF SINGLE-CRYSTAL COPPER FILMS AT LOW TEMPERATURES. A.Yelon and R.W.Hoffman.

pl. Phys., Vol. 31, No. 9, 1672-4 (Sept., 1960).

A method is described for the production of single-crystal films pper at temperatures as low as −40°C. This method utilizes the xy of copper on rocksalt. A thin layer of copper is evaporated single crystal of salt at 350°C. Then a thick layer is evaporated e low temperature. Films grown by this method have been ex-ed using X-ray and etching techniques. It was found that some ese films had single-crystal regions of 1 mm diameter and er. These crystallites had [100] directions within 1° to a normal e film surface.

539.23

6360 FORMATION OF THIN POLYMER FILMS BY ELECTRON BOMBARDMENT. R.W.Christy.

ppl. Phys., Vol. 31, No. 9, 1680-3 (Sept., 1960).

Thin insulating films, less than 100 A thick to a few thousand stroms, were produced by bombarding a substrate with electrons e presence of silicone oil vapour. The rate of deposition of the d film was found to depend on the substrate temperature, elec- beam current density, and oil vapour pressure. A theoretical ession for the rate is given, which agrees satisfactorily with experimental data. The films which were produced had excellent lating properties.

539.23

6361 EVAPORATION SOURCE WITH CONTROLLED CHARACTERISTICS. E.M.DaSilva.

. sci. Instrum., Vol. 31, No. 9, 959-60 (Sept., 1960).

Reproducible and constant evaporation rates can be realized n an evaporant is heated by radiation. A basic source structure escribed with the controlled characteristics necessary for roducible thin film techniques. Particular attention to the sim-ity of design and application has provided an easily constructed ctical source.

539.23

16362 TEMPERATURE DEPENDENCE OF THE GRANULATION PHENOMENA OF THIN FILMS OF GOLD.

roitoru, A.Dévényi and G.Giobanu.

d. Cercetari Fiz., Vol. 10, No. 1, 79-86 (1959). In Roumanian.

Studied using an electron microscope. It is shown that for h thickness between 25 and 165 A there is a temperature T_m which a granular structure appears. The thickness of the films determined by measuring their optical transmission.

539.23

16363 PROPERTIES OF Ag_2Se films. W.Sander.

Phys., Vol. 159, No. 4, 456-61 (1960). In German.

Thin films of Ag_2Se were condensed onto a substrate at low perature. The infrared transmission and the electrical resistivity e measured after condensation and during annealing and the ye—Scherrer diagrams taken. After condensation at 80°K the Se-films are amorphous. At 150-170° they crystallize in a cubic cture. This structure corresponds to a high-temperature dification, which in thermodynamic equilibrium exists only above °C.

539.23 : 537.3

16364 TRANSPARENT INDIUM CONTACTS TO CdS. Y.T.Sihvonen and D.R.Boyd.

. sci. Instrum., Vol. 31, No. 9, 992-4 (Sept., 1960).

Diffusion and sputtering techniques are described for applying low resistance, highly transparent, antireflecting, electrical contacts to CdS. The diffusion process entails heating CdS for several minutes in the presence of indium vapour. The resulting crystal surface resistance has been adjusted to range as low as 12 ohms/square without any observable crystal discoloration. The sputtering process employs an 82-18% indium—tin alloy that is placed onto the crystal surface using oxygen as the sputtering atmosphere. The resulting film is Sn-doped In_2O_3, measuring 100-150 ohms/square, and showing 80-100% transmittance from 4600 to 20 000 A.

539.23 : 541.13

16365 THE CONSTITUTION OF ELECTRODEPOSITED METALS [AS INFERRED] FROM DATA OF STRUCTURAL INVESTIGATIONS.

K.M.Gorbunova, V.V.Bondar, V.P.Moiseev, O.S.Popova, Yu.M.Polukarov and A.A.Sutyagina.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 73-80(1960). In Russian.

The results of investigations, carried out both in U S.S.R. and abroad, are discussed, and it is concluded that by varying the conditions of electrodeposition, metal deposits can be obtained with electrical, magnetic, mechanical, and other properties, not possessed at normal temperatures by metals, prepared by other methods. M.H.Sloboda

X-ray and Electron Microscope Examination

539.27

16366 ELECTRON-MICROSCOPIC INVESTIGATIONS ON NaCl CRYSTALS. K.Árkosi and Z.Morlin.

Acta phys. Hungar, Vol. 8, No. 1-2, 129-46 (1957). In German.

The microstructure of natural, synthetic and recrystallized NaCl samples was investigated by electron microscopy, and the results of other authors were verified. It was found that: (i) the structure depended on the preparation of the samples; (ii) during the growth of synthetic crystals internal stresses arose which could not be annealed completely; (iii) the mechanism of recrystallization under high pressure was independent of temperature and of pressure; (iv) the structure of natural monocrystals deformed by bending became similar to the structure of synthetic crystals; (v) the structures of crystals with similar electrical conductivities and optical strain characteristics were analogous. H.E.Schmid

539.27 : 539.2

16367 ELECTRON MICROSCOPE IMAGES OF DISLOCATIONS. H.Hashimoto and K.Fujita.

Nature (London), Vol. 187, 51-2 (July 2, 1960).

With a single optical analogue (plane grating of 66 μ spacing and an almost parallel light beam of λ = 4900 A) it is possible to demonstrate both the white spots obtained by Hirsch et al. (Abstr. 2819 of 1957) and by Bollman (Abstr. 1681 of 1957) in the electron microscope image of a thin metallic film and the extra terminating half-life in the electron microscope image of platinum phthalocyanine observed by Menter (Abstr. 7031 of 1956). The optical experiment gives a satisfactory qualitative explanation of how the two types of dislocation contrast arise. J.Iball

539.27

16368 A NEW METHOD FOR DETERMINING THE HEIGHT OF HEMISPHERICAL PARTICLES WITH THE ELECTRON MICROSCOPE. R.Grigorovici, N.Croitoru and A.Dévényi.

Rev. de Physique (Bucarest), Vol. 4, No. 4, 409-13 (1959). In German.

The usual method of height determination by shadowcasting is approximate since the shadowing angle is not known with any accuracy and to achieve constant lengths of shadow, very flat surfaces are needed. Rubber latex particles of known size and hemispherical particles of evaporated Pb were shadowed simultaneously on a smooth quartz surface. The latex enabled the shadowing angle to be computed accurately and this was used to determine the height of the neighbouring Pb particles. R.Reed

PHYSICAL CHEMISTRY

THERMOCHEMISTRY . REACTIONS

541.12

16369 CHEMICAL EQUILIBRIUM IN MULTICOMPONENT POLYPHASE SYSTEMS. E.P.Boynton.

J. chem. Phys., Vol. 32, No. 6, 1880-1 (June, 1960).

The method of steepest descents and the minimization of free energy is applied in the treatment of a polyphase system in which condensed phase solutions may occur. W.Good

541.12

16370 DIFFUSION AND HETEROGENEOUS REACTION. III. ATOM RECOMBINATION AT A CATALYTIC BOUNDARY. H.Motz and H.Wise.

J. chem. Phys., Vol. 32, No. 6, 1893-4 (June, 1960).

Previously derived relationships (Abstr. 9173 of 1956) for reaction of labile species in a cylinder of finite length and catalytic activity are modified and it is shown that for surfaces with large recombination coefficients the correction becomes important. W.Good

541.12

16371 AN INVESTIGATION OF THE PARTIAL OXIDATION OF PULVERIZED CUPROUS OXIDE TO CUPRIC OXIDE. P.Brüesch.

Z. angew. Math. Phys., Vol. 10, No. 5, 519-24 (1959). In German.

X-ray and electron-diffraction tests show that, with the aid of a combined oxidizing oven and air sifting apparatus, it is possible to achieve partial oxidation of the Cu_2O particles in a powder in such a way that each Cu_2O particle is encased within a composite CuO layer. The thinnest CuO layer which can still be shown to be composite has a mean thickness of about 120 A according to an approximate method of calculation. The procedures adopted for this experiment cannot determine whether still thinner layers are also composite. The thickness of the CuO layers increases exponentially with the oxidation temperature. This work has been undertaken in conjunction with research into the ice-forming nucleability of substances.

541.12 : 539.2 : 548.5

REACTION RATE AND GROWTH FORMS OF REACTION PRODUCT IN THE SYSTEM $Ag-H_2S$. See Abstr. 16257

541.12

16372 COMMENT ON THE HOMOGENEOUS EXCHANGE REACTION BETWEEN HYDROGEN AND DEUTERIUM. A.Cimino, E.Molinari and G.G.Volpi.

J. chem. Phys., Vol. 33, No. 2, 616-17 (Aug., 1960).

See Abstr. 3293 of 1960. Oxygen adsorbed on the walls of the reaction vessel can have a perturbing action on the exchange reaction between hydrogen and deuterium even if oxygen diffusion through the walls is precluded. G.I.W.Llewelyn

541.12

16373 CALCULATION OF EQUILIBRIUM CONSTANTS FOR SEVERAL ISOTOPE EXCHANGE REACTIONS INVOLVING N_2O_4. E.U.Monse.

J. chem. Phys., Vol. 33, No. 1, 312-14 (July, 1960).

These have been calculated (using recent vibration frequency assignments for N_2O_4) for the exchange of N and of O between N_2O_4 and NO_2 and between N_2O_4 and NO. W.Good

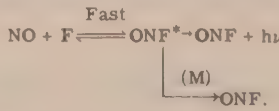
541.12

16374 NITRIC OXIDE—FLUORINE DILUTE DIFFUSION FLAME. D.Rapp and H.S.Johnston.

J. chem. Phys., Vol. 33, No. 3, 695-9 (Sept., 1960).

The dilute diffusion flame method for measuring the rates of fast gas reactions was used to study the reaction $2NO + F_2 = 2ONF$. The reaction proceeds with the emission of visible light, and photographic methods were used to obtain concentration profiles in space. The results were interpreted in terms of the mechanism

$$NO + F_2 \longrightarrow ONF + F \text{ (rate determining)}$$



$$NO + F \xrightleftharpoons{\text{Fast}} ONF^* \rightarrow ONF + h\nu \qquad ONF^* \xrightarrow{(M)} ONF.$$

The interpretation of results is somewhat ambiguous. The observed rate may be that for the first step, in which case the rate consta has a pre-exponential factor of 6×10^{11} cm^3/mole-sec and an activation energy of 1.5 ± 1.0 kcal between room temperature ar dry ice temperature. Alternatively the observed rate may be a composite of at least four of the elementary steps given above. With a reasonable assignment of rate constants for the succeedi steps, the first alternative is favoured, although the margin of safety is not great.

54

16375 INFLUENCE OF SMALL QUANTITIES OF NICKEL O THE OXIDATION OF COPPER. F.Bouillon and J.Stevens.

Acta metallurgica, Vol. 7, No. 12, 774-6 (Dec., 1959). In Frenc

The authors have studied the influence of small quantities o nickel on the oxidation of copper in pure oxygen at atmospheric pressure, at temperatures equal to and below 200° C. Under the conditions, there always exists a large region where only Cu_2O i formed. This study shows that: (1) the alloys of Cu—Ni containi 5 and 10% nickel oxidize less rapidly than pure copper during th period studied; (2) alloys containing 0.5 and 1% nickel oxidize m rapidly during an initial period, the length of which varies invers with the nickel content; (3) the alloys containing 0.1% oxidizes th most rapidly during the period investigated; (4) the oxide CuO al appears sooner on these alloys.

54

16376 STRUCTURAL EFFECTS IN THE CHEMICAL REACTIVITY OF SILICA AND SILICATES. F.M.Ernsberger.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 347-51 (June, 1960).

The attack of quartz by hydrofluoric acid proceeds at a rate approximately a hundred-fold greater on the optic axial plane tha on the prism faces. The rate of attack on coesite is nil. Mica ar certain other silicates are resistant to hydrofluoric acid attack o certain crystal faces. A reaction mechanism is proposed to acc for these facts. This mechanism predicts that in a perfect cryst only those crystal faces which expose simultaneously two of the f oxygen atoms of a given silica tetrahedron are attacked by hydrofluoric acid. Coesite is a special case, in that the close-packing which is assumed to exist provides double the normal number of tetrahedral sites. Surface silicon atoms may occupy some of the vacant sites, with the result that no unsaturated oxygen atoms ar exposed at the surface.

541

16377 LIMITATIONS OF THE REFLECTED-SHOCK TECHNIQUE FOR STUDYING FAST CHEMICAL REACTIONS. T.A.Brabbs, S.A.Zlatarich and F.E.Belles.

J. chem. Phys., Vol. 33, No. 1, 307-8 (July, 1960).

The possibility of determining reaction temperature behind a reflected shock wave by simultaneous measurement of incident M number, reflected Mach number, and reflected shock pressure is investigated. It is concluded that reaction temperatures derived from pressure measurements are the most accurate. G.I.W.Llewe

541

16378 COMMENTS ON HYPERVELOCITY WAVE PHENOME IN CONDENSED EXPLOSIVES. R.F.Chaiken.

J. chem. Phys., Vol. 33, No. 3, 760-61 (Sept., 1960).

The occurrence of hypervelocity wave phenomena in condens explosives during shock initiation to detonation is discussed in terms of an adiabatic reaction model for the chemical energy rel (i.e., the detonation reaction). On the basis of the model, the chemical reaction exhibits an apparent induction time resulting i sudden release of energy behind the initiating shock front. It is believed that this energy release leads to a propagated high-pres reaction wave which moves in the shock compressed explosive at "super-velocity" (i.e., greater than the normal steady-state veloc to overtake the initiating shock front. The proposed explanation i consistent with the reported observations of hypervelocity wave phenomena in detonating liquid nitromethane and single crystals PETN.

541.12 : 534.

SOUND VELOCITY IN EXPLOSION PRODUCTS. See Abstr. See Abstr. 14728

541.12 : 533.6

EMPERATURE OF A PLANE LAMINA AROUND WHICH
'S A REACTING GASEOUS MIXTURE. See Abstr. 14674

ELECTROCHEMISTRY

541.13

379 EXCESS FREE ENERGY IN DEHYDROGENATED PALLADIUM. J.M.Singer and G.W.Castellan.
m. Phys., Vol. 33, No. 2, 633-4 (Aug., 1960).

Untreated" Pd is more noble by 0.02 V than either the gas-
ed or the electrolytically charged metal. This difference shows
distortion free energy of about 900 cal/mole remains in the
after it was charged with hydrogen and then dehydrogenated.
ate of removal of hydrogen from the gas-charged alloy by ceric
ate may be more than five times slower than the rate of re-
l from the electrolytically charged alloy. R.Schnurmann

541.13

6380 HEAVY-WATER ELECTROLYSIS UNIT FOR GENERATION OF DEUTERIUM GAS PROVIDED WITH AUTO-
IC SWITCH-OFF AND SAFETY DEVICES. P.K.Dutt.
i. Instrum., Vol. 37, No. 9, 352-3 (Sept., 1960).

An electrolysis apparatus has been constructed for the safe
rouble-free generation of deuterium gas from heavy water for
rimental purposes. It has been found particularly suitable for
ducing the gas at a rate of millilitres per minute (s.t.p.) into
uum system without the use of an extra pumping unit, because
lectrolysis is done under atmospheric pressure and not in a
um. The apparatus is equipped with electrical control-relays
eeds little attention. It operates within a specified pressure
e of the liberated deuterium gas, and is automatically shut off
e pressure exceeds a certain value. There is an almost complete
nce of danger of explosion arising from the electrical devices
ld be generated deuterium gas be accidentally mixed with air.

541.13 : 532.6

DROPPING MERCURY ELECTRODE. DROP FORMATION.
Abstr. 14612

541.13 : 532.7

DIFFUSION IN AN ELECTROLYTE. See Abstr. 14637

541.13 : 539.23

ELECTRODEPOSITED METAL FILMS. See Abstr. 16365

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

6381 PHOTOCHROMOTROPISM OF GAMMA-(2,4-DINITROBENZYL)-PYRIDINE IN SOLUTION.
Mosher, C.Souers and R.Hardwick.
em. Phys., Vol. 32, No. 6, 1888-9 (June, 1960).

The crystalline solid is inactive but alcoholic solutions at low
eratures turn a deep violet colour on exposure to radiation in
lue and ultraviolet regions. An intra-molecular hydrogen
sfer mechanism is proposed to account for the phenomenon.
W.Good

541.14 : 539.19

PHOTOCHEMICAL DISSOCIATION OF KETENE. See
r. 15683

541.14

6382 THE PRODUCTION OF VIBRATIONALLY EXCITED S_2 IN THE ISOTHERMAL FLASH PHOTOLYSIS OF S_2Cl_2.
.McGrath.
em. Phys., Vol. 33, No. 1, 297-8 (July, 1960).

Two band systems are observed in absorption 30 μ sec after the
and are attributed respectively to S_2 and (tentatively) S_2Cl
cals. W.Good

541.15

16383 DETECTION OF SHORT-LIVED TRANSIENTS IN RADIATION CHEMISTRY.
M.S.Matheson and L.M.Dorfman.
J. chem. Phys., Vol. 32, No. 6, 1870-1 (June, 1960).

Synchronized flash absorption spectroscopy in solutions irradiated with a 5 μsec pulse of 15 MeV electrons at an average current of 0.1 amp was used to study transient species in 0.01 M benzyl chloride in cyclohexane, 0.01 M allyl chloride in water, 0.01 M allyl alcohol in water, 0.004 M 1.4 cyclohexadiene in cyclohexane, 0.007 M KI in water, and 0.04 M $KBrO_3$ in water. It was possible to recognize the spectrum of the benzyl radical with a half-life of less than 30 μsec, of the I_2^- and I_3^- ions; of the BrO_3 radical with a half-life of approximately 10 μsec and of the BrO radical. Other non-identified species were observed. M.Ebert

541.15

16384 KINETICS OF THE ALPHA RADIOLYSIS OF CARBON MONOXIDE. P.S.Rudolph and S.C.Lind.
J. chem. Phys., Vol. 33, No. 3, 705-8 (Sept., 1960).

The radiolytic decomposition of CO induced by alpha particles appears to be initiated by two reactive species, CO^+ and CO^*. The products of the reaction are CO_2 and the solids $(C_3O_2)_x$ and graphite. Carbon dioxide formed during the reaction depletes the CO^+ by charge transfer. Thus, when CO_2 pressure becomes sufficiently high, CO^* only initiates reaction. The reaction mechanism suggested is consistent with previous ionization and photochemical studies in the CO system.

541.15

16385 CORRELATION OF MOLECULAR YIELDS IN HYDROCARBON RADIOLYSES WITH MASS SPECTRAL DATA.
L.M.Dorfman and M.C.Sauer, Jr.
J. chem. Phys., Vol. 32, No. 6, 1886-7 (June, 1960).

The radiolysis in the gas phase at room temperature of methane, ethylene, ethane and propane has been surveyed. Molecular detachment yields, rather than total produce yields, were chosen to check the correlation with mass spectral data. Radiation chemical data were taken from the literature and mass spectral patterns are based on API tables for 70 V electrons using the W-values of 27.3, 26.5, 24.6 and 24 eV per ion pair for CH_4, C_2H_4, C_2H_6 and C_3H_8 respectively. All observed pertinent ion molecule reactions were included. The correlation between observed and calculated data is striking and suggests that unionized excited states contribute little to the molecular yield. The major uncertainties in these calculations are the fragmentation pattern for electron energies commonly used in radiation chemical experiments and the competition between unimolecular dissociation and ion molecule reaction of the parent ion.
M.Ebert

541.15

16386 POSSIBLE ION-MOLECULE REACTION IN THE GAMMA RADIOLYSIS OF C_3 HYDROCARBONS. K.Yang.
J. chem. Phys., Vol. 32, No. 6, 1892 (June, 1960).

Radiolysis of propane—nitric oxide mixtures gave a $G(C_2H_6) = 1.5$ molecules/100 eV whereas propylene or cyclopropane both with nitric oxide gave $G(C_2H_6) = 0$ molecules/100 eV. Mass spectral data show in the case of the propane mixture a 30.8% intensity for the $C_2H_5^+$ ion whereas the other two hydrocarbon mixtures have 0.1% and 0% $C_2H_5^+$ intensity. It follows that radiolysis proceeds according to $C_2H_5^+ + C_mH_n = C_2H_6 + C_mH_{n-1}^+$. M.Ebert

541.15

16387 GAMMA RADIOLYSIS OF PROPANE.
B.F.Birdwell and G.W.Crawford.
J. chem. Phys., Vol. 33, No. 3, 928-9 (Sept., 1960).

Propane gas was irradiated with Co^{60} γ-rays. The primary products formed by the decomposition of 0.9-3.2% of the original propane were identified. Based on hydrogen yield, the relative yields of the products are: hydrogen (1.00), hexanes (0.70), ethane (0.32), methane (0.27), butanes (0.17), and pentanes (0.08).

541.15

16388 DISSOCIATION OF METHYL BROMIDE BY NUCLEAR ISOMERIC TRANSITION OF 4.4 HR Br^{80m}.
S.Wexler and G.R.Anderson.
J. chem. Phys., Vol. 33, No. 3, 850-7 (Sept., 1960).

The pattern of positively charged fragments from methyl bromide as a result of isomeric transition of 4.4 hr Br^{80m} was measured by mass spectrometric techniques. A peaked distribution of charge states of atomic bromine ranging from Br^{1+} to Br^{13+} was observed, the most probable being Br'^{+}. The finding of singly, doubly, and triply charged carbon-containing fragments gives evidence that the CH_3Br^{80} daughter ion breaks apart by Coulombic repulsion of redistributed charges following internal conversion and subsequent Auger electron transitions. Multiply charged polyatomic species produced by the nuclear transition are unstable.

DISPERSIONS . COLLOIDS ADSORPTION

541.18

16389 DETERMINATION OF THE PARTICLE SIZE OF POLONIUM RADIOCOLLOIDS.
R.Lindner, H.Reinhardt and J.O.Liljenzin.
Z. Naturforsch., Vol. 15a, No. 7, 643-4 (July, 1960). In German.

The diffusion coefficient was very small in the range of $p_H = 6\text{-}7$, compared with $p_H = 0\text{-}1$. For $p_H = 6.55$ the average radius of the colloid particles was 1.6×10^{-4} cm. R.Schnurmann

541.18

16390 A NOMOGRAM FOR CALCULATION OF PARTICLE DIAMETERS FROM TURBIDITY USING MIE'S EQUATION. I.Ya.Slonim.
Optika i Spektrosk., Vol. 8, No. 2, 255-7 (Feb., 1960). In Russian.

Gives a nomogram for calculation of the particle diameter D (in cm) from the characteristic turbidity, $[\tau]$, defined as

$$[\tau] = \lim_{C_{vol} \to 0} (\tau/C_{vol})$$

where τ is the turbidity, and C_{vol} is the relative volume of solid particles in a suspension The characteristic turbidity, $[\tau]$, occurs in Mie's equation which relates the light scattering coefficient, K, with $[\tau]$ and D: $3K = 2[\tau]D$. A.Tybulewicz

541.18 : 534.23

ACOUSTIC ATTENUATION AND DISPERSION IN AEROSOLS. See Abstr. 14740

541.18 : 537.56

CHARGING OF NON-MICROSCOPIC AEROSOL PARTICLES. See Abstr. 14976

541.18

16391 YIELD STRESS EXERTED ON A BODY IMMERSED IN A BINGHAM FLUID. G.Boardman and R.L.Whitmore.
Nature (London), Vol. 187, 50-1 (July 4, 1960).

Measurements were made of the extreme values of the vertical force that can be exerted on a rectangular block in equilibrium in an aqueous suspension of clay, for some different orientations of the block. The force needed to overcome the yield value of the suspension is greatest when the block face of greatest area is horizontal. J.G.Oldroyd

541.18 : 532.5

AN EXTENSION OF GOODEVE'S IMPULSE THEORY OF VISCOSITY TO PSEUDOPLASTIC SYSTEMS. See Abstr. 14581

541.18

16392 SECOND-ORDER PERTURBATION CALCULATION OF THE HINDERED ROTATOR MODEL FOR ADSORBED HYDROGEN. A.A.Evett.
J. chem. Phys., Vol. 33, No. 3, 789-94 (Sept., 1960).

A refinement of the previously reported models (Abstr. 12741 of 1959) for adsorbed hydrogen is presented, based on the assumption that each hydrogen atom interacts with the adsorbent by a van der Waals force of the Lennard-Jones type. The calculation is accomplished by using the previous model based on a parabolic potential-well interaction, for which exact wave-functions are obtained, as the zeroth-order approximation and then carrying out a second-order perturbation calculation to obtain accurate results for the Lennard-Jones type interaction. The results lead to the conclusion that agreement with data on ortho—para hydrogen separation coefficients can be obtained only by assuming a magnitude for the rotational barrier which is inconsistent with data on adsorption energies. To eliminate this discrepancy a perturbing term involving a hindrance to rotation in the plane parallel to the surface is introduced and a second-order perturbation analysis shows that such a term can lead to agreement with both separation coefficient and adsorption energy data.

54

16393 SEDIMENTATION OF POLYDISPERSE MACROMOLECULES. P.R.Gupta and D.A.I.Goring.
J. chem. Phys., Vol. 32, No. 6, 1890-1 (June, 1960).

The ultracentrifugal analysis of alkali lignin indicated its polydispersity. Supporting evidence was obtained from measurements of the variation of sedimentation coefficient with gravitati field for serum albumin and alkali lignin. For the alkali lignin t sedimentation coefficient increased markedly at low fields (30×10^3g and 11.5×10^3g) in contrast to the relatively constant values found for the monodisperse serum albumin over the whol range from 260×10^3g to 11.5×10^3g. R.Schnurr

54

16394 SIMPLE TECHNIQUE FOR THE AUTOMATIC RECO ING OF MONOLAYER COMPRESSION CHARACTERISTICS. J.A.Mann, Jr and R S.Hansen.
Rev. sci. Instrum., Vol. 31, No. 9, 961-3 (Sept., 1960).

Trurnit and Lauer (Abstr. 2162 of 1960) described an autom recording film balance system suitable for automatic recording many properties of insoluble surface films. A similar instrume somewhat less versatile, but very simply constructed by modifyi a Cenco hydrophil balance, was used for automatic recording of force-area curves for monolayers spread on aqueous substrates Major components include a linear differential transformer, lea screw barrier advance system, and an x-y recorder. The practi ity of the apparatus was demonstrated on a stearic acid monolay spread from benzene on a distilled water substrate. Sensitivity 0.01 dyne/cm in spreading pressure and 0.1 A^2 in molecular co was readily obtained, together with a surface pressure range of 0-60 dyne/cm.

54

16395 INFLUENCE OF WATER VAPOUR ON THE INTERACTION OF GERMANIUM AND OXYGEN.
R.Kh.Burshtein, L.A.Larin and G.F.Voronina.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 148-51 (July 1, 1960). In Russian.

Measurements are reported on the velocity of adsorption of oxygen by prepared surfaces of germanium as affected by the presence of water vapour. The contact potential was measured a a function of water vapour pressure for a pure germanium surfa a germanium surface covered with an oxide layer, and a surface conditioned by repeated cycling. The adsorption of oxygen and o water vapour lead to an increase in the contact potential and the significance of this behaviour in the practical use of semiconduct devices is briefly pointed out. R.F.S.Hear

541.18 : 5

CONTRIBUTION TO THE STUDY OF THE ADSORPTION OF ACIDS AND ALCOHOLS OF SATURATED STRAIGHT-CHAIN HYDROCARBONS. See Abstr. 14615

541.18 : 53

DISTRIBUTION FUNCTIONS OF A FLUID IN AN EXTERNAL POTENTIAL FIELD: APPLICATION TO PHYSICAL ADSORPTIO See Abstr. 14624

541.1 : 5

DIELECTRIC STUDY OF THE ADSORPTION OF WATER B MAGNESIUM HYDROXIDE. See Abstr. 14945

PHYSICAL METHODS OF CHEMICAL ANALYSIS

545 : 539.2 : 537.2 : 621.315.61

16396 USE OF INFRARED SPECTROSCOPY IN THE STUDY OF CAPACITOR PAPER. M.S.Kozÿreva and V.T.Ren
Fiz. tverdogo Tela, Sbornik [Supplement] I, 285-8 (1959). In Russian

Shows that infrared spectrochemical analysis can be used to study chemical reactions occurring during heating of capacitor pa in air and also to distinguish between various types of paper A.Tybulewi

545

6397 EMISSION SPECTROCHEMICAL ANALYSIS IN THE FAR ULTRAVIOLET OF POWDERS CONTAINING THE .LOWING ELEMENTS: GERMANIUM, ARSENIC, SELENIUM,)MINE, TIN, ANTIMONY, TELLURIUM.

alloffet, J.Romand and B.Vodar.
hys. Radium, Vol. 20, No. 4, 509-12 (April, 1959). In French.

The sensitive lines corresponding to transitions in ions with one wo optical electrons only are tabulated, showing the wavelengths)-1400 A), degree of ionization (3-7) and the transition. Test nents were mixed with titanium oxide and excited by capacitor F, 20 kV) discharge and the spectra were photographed and rophotometered. Calibration curves from known-mixtures are en; minimum concentrations detectable are 50-300 p.p.m.

G.F.Lothian

545

16398 GAS CHARACTERISTICS OF AN OPTICO-ACOUSTIC GAS ANALYSER. A.O.Sall'.

ika i Spektrosk., Vol. 8, No. 2, 247-52 (Feb., 1960). In Russian.

Deals with determination of the ratio of the signal produced by ring the amount of the component to be analysed in a gas mix- e to the signal due to the total radiation flux. This ratio was nd by means of "gas characteristics" of the analyser, which are dependences of the signal at the receiver output on the product he length of the working chamber and the concentration of the nponent whose amount is to be found. A.Tybulewicz

545

16399 A SINGLE-BEAM OPTICO-ACOUSTIC GAS ANALYSER. M.L.Veingerov and A.A.Sivkov.

tika i Spektrosk., Vol. 8, No. 5, 735 (May, 1960). In Russian.

Suggests that it is possible to construct a highly sensitive and curate single-beam, single-channel optico-acoustic gas analyser the following way. The light from a modulated source is made pass through a working cell and reaches an optico-acoustic ceiver fitted with an internal microphone. The microphone signal fed via a high-quality amplifier to a d.c. indicating instrument. e calibration signal used normally in double-beam gas analysers replaced by a voltage from an auxilliary stabilized source which connected directly to a d.c. instrument. A.Tybulewicz

545

16400 MASS SPECTROMETRIC STUDIES OF ION—MOLECULE REACTIONS IN MIXTURES OF METHANE, METHANOL, ATER, ARGON AND KRYPTON WITH IODINE: PARTICIPATION F EXCITED IONS AND ATOMS AND SOME RADIATION CHEMICAL ONSIDERATIONS. A.Henglein and G.A.Muccini.

. Naturforsch., Vol. 15a, No. 7, 584-93 (July, 1960). In German.

The mass spectrum of an iodine—methane mixture contains econdary ions of the type CH_nI^+ (n = 0–4) which are attributed to e ion—molecule reactions $CH_n^+ + I_2 \rightarrow CH_nI^+ + I$ and $CH_{n+1} + I_2 \rightarrow$ $CH_nI^+ + HI$. CH_4I^+ appears at 10.7 V, i.e. 1.3 V above the ionization po- ntial of iodine and 1.6 V below that of methane. The form of the ioniza- on efficiency curve of CH_4I^+ resembles that of the excitation curves atoms. The precursor of CH_4I^+ is therefore assumed to be an ex- ted iodine ion: $I_2^{+*} + CH_4 \rightarrow CH_4I^+ + I$. It is shown that this re- ction probably is endothermic when induced by an iodine ion without excess energy. The excited iodine ion is also the precursor of CH_4OI^+ and H_2OI^+ in iodine mixtures of methanol and water respectively. I_3^+ has been observed in iodine vapour. It is formed by $I_2^+ + I_2 \rightarrow I_3^+ + I$ where the iodine ion is not excited. AI^+ appears at the excitation potential of the metastable argon atom (11.5 V). The reaction $A(^3P_2) + I_2 \rightarrow AI^+ + I + e$ is therefore postulated. However, the reaction $A^+ + I_2 \rightarrow AI^+ + I$ also occurs at higher electron voltages as could be concluded from repeller field studies. KrI^+ does not appear at the excitation potential of the metastable state since the reaction $Kr(^3P_2) + I_2 \rightarrow KrI^+ + I + e$ seems to be slightly endothermic. The KrI^+ ion appears 0.6 V below the ionization potential of krypton which indicates the participation of a highly excited state in its formation. Iodine appears as an efficient positive ion scavenger since it is able to react with many molecular and fragment ions with cross-sections of the order of 50 A^2. Simple calculations show that this action of iodine should be taken into consideration in radical scavenging experiments in radiation chemical studies.

545

16401 ISOTOPIC ANALYSIS OF BORON IN BORON TRIFLUORIDE BY MASS SPECTROMETRY, AND MEASUREMENT OF NATURAL BORON 10 CONCENTRATION. P.G.Bentley.

J. sci. Instrum., Vol. 37, No. 9, 323-8 (Sept., 1960).

A conventional mass spectrometer is used for precise measurements of the isotope ratios of boron in boron trifluoride samples with widely differing concentrations of B^{10}. "Memory" effects caused by the adsorption of boron trifluoride on to the surfaces of the inlet system have been investigated, and it is found that these can be reduced to a workable level by careful design of the inlet system. By blending together enriched and depleted boron trifluoride, standard samples with known isotopic constitutions are prepared and used to calibrate the mass spectrometer. The true and measured isotope ratios are thus found to differ by several %, an effect attributed to mass discriminations in the ion source. After correcting for this error, the B^{10} atomic concentration in some naturally-occurring boron is found to be 19.27 ± 0.13%.

545 : 536.2

16402 EFFECT OF CARRIER GAS ON THE SENSITIVITY OF THERMAL CONDUCTIVITY DETECTORS.

C.Bokhoven and A.Dijkstra.
Nature (London), Vol. 186, 793-4 (June 4, 1960).

Sensitivity values for methane, and for propane, in hydrogen and in nitrogen, obtained experimentally with a four-wire thermal conductivity detector, are tabulated and compared with values calculated from Ray's formula (Abstr. 4096 of 1959), and from $dt/dx = a(k_1 - k_2)/k_1k_2$, where t is the wire temperature, x the volume fraction of the vapour in the carrier gas and k_1, k_2 the thermal conductivities of the carrier gas and vapour, respectively. The agreement is poor. S.Weintroub

545 : 535.33

DETERMINATION OF SILICON AND PHOSPHORUS IN IRON. See Abstr. 14828

545 : 548.7 : 539.2

CRYSTALLOGRAPHIC ASPECTS OF EXTRA REFLECTIONS IN X-RAY SPECTROCHEMICAL ANALYSIS. See Abstr. 16296

GEOPHYSICS

550.3

16403 EVALUATION OF THE SECOND, FOURTH AND SIXTH HARMONICS IN THE EARTH'S GRAVITATIONAL OTENTIAL. D.G.King-Hele.

ature (London), Vol. 187, 490-1 (Aug. 6, 1960).

By considering the rate of rotation of the orbital planes of n arth satellites with different orbits the first n even harmonics can e approximately obtained. Values for the second, fourth and sixth armonics as derived from observations of Sputnik II, Vanguard I nd Explorer VII are given. These are consistent with results from ther sources. H.Morrison

550.3

16404 THE NEUTRON RADIATION OF MOUNTAIN ROCKS. G.V.Gorshkov and N.M.Lyatovskaya.

okl. Akad. Nauk SSSR, Vol. 133, No 1, 92-4 (July 1, 1960). In ussian.

A theoretical discussion of the high neutron flux found in mountains by comparison with that of sea level. Effects of natural α-particle bombardment and spontaneous fission of U^{238} are considered. J.M.Hough

550.3

16405 SOME FEATURES OF MAGNETIC ELEMENTS AT TRIVANDRUM AND ANNAMALAINAGAR, SITUATED NEAR THE GEOMAGNETIC EQUATOR IN THE INDIAN PENINSULA. A.Yacob.

Indian J. Meteorol. Geophys., Vol. 10, No. 4, 377-92 (Oct., 1959).

The Sq diurnal variation in H at Trivandrum and Annamalainagar are found to be large compared with those at Alibag. The quiet day range in H at Trivandrum in the month of March is abnormally large. Though the Sq variations in V at Trivandrum are not abnormal they are larger than those at Annamalainagar and Alibag. The response of the H elements to disturbance at Trivandrum, Annamalainagar as well as Alibag are similar in sense. But the V element at Annamalainagar shows a difference in its response to disturbance

When the V elements at both Alibag and Trivandrum show an increase in numerical magnitude the V element at Annamalainagar shows a decrease and vice versa. When the magnitudes of disturbance are examined they are found to be almost the same as the H element at all the observatories (including Alibag) during night hours. But during the day the magnitudes of disturbance in H element at Trivandrum and Annamalainagar are always greater than that at Alibag, a station away from the geomagnetic equator. Effects of disturbance in the V element are greatest at Trivandrum both during the day as well as the night. The lines of force of an average disturbance field in a longitudinal plane over the region of the Indian Peninsula appear to be smooth curves with their concave side turned upwards, their turning points occurring between Annamalainagar and Alibag during the day and close to Alibag in the night.

550.3

16406 THE DIURNAL VARIATION OF SIZES OF SUDDEN COMMENCEMENTS AND IMPULSES IN THE KODAIKANAL MAGNETOGRAMS. B.Srinivasamurthy.

Indian J. Meteorol. Geophys., Vol. 11, No. 1, 64-8 (Jan., 1960).

Combined data of sudden commencements and sudden impulses recorded at Kodaikanal (geomagnetic latitude 0.6°N) during the period 1949-57 have been analysed in order to study the relationship between the diurnal variation in the amplitudes of the impulses and the diurnal variation in the horizontal component of the earth's magnetic field (the Sq variations in H). There is a statistically significant daytime enhancement in sudden commencement sizes similar to the enhancement in Sq variation. Furthermore, this enhancement is larger on days with larger Sq variation than on days with smaller Sq variation. These results confirm those obtained by Forbush and Vestine (1955) at Huancayo, another station near the geomagnetic equator.

550.3

16407 OBSERVED MAGNETIC EFFECTS FROM METEORS.

A.W.Jenkins, Jr, C.A.Phillips, Jr and E.Maple.

J. geophys. Res., Vol. 65, No. 5, 1617-19 (May, 1960).

See Abstr. 5432 of 1950; 1942 of 1959. A preliminary analysis of data from the I.G.Y. programme on geomagnetic fluctuations in the range 1-50 c/s, indicates a correlation between meteoric activity and the average (rectified and integrated) level of fluctuation. The frequency range was subdivided into six approximately octave bands. For every major meteor shower, with one possible exception, in the three months considered, there is a peak in geomagnetic activity in the 1-5 c/s bands only. Other peaks occur, not coincident with meteor showers, but these appear in all the six bands and are attributed to thunderstorms. D.M.Gilbey

550.3

16408 CONCERNING THE NATURE OF SHORT-PERIOD MAGNETIC MICROPULSATIONS. W.H.Campbell.

J. geophys. Res., Vol. 65, No. 6, 1843-5 (June, 1960).

Both world-wide and local observations indicate that magnetic micropulsations originate in the ionosphere. Their amplitude is a measure of ionospheric electron density. Micropulsations belong to the class of events related to the arrival of solar-terrestrial particles; and they exhibit all the major features associated with this type of disturbance. They are linked also with the appearance of pulsating aurorae; and they probably represent a pulsating electromagnetic field capable of supplying periodically enough additional energy to raise the excited solar particles to an energy level which is sufficient to initiate the auroral emissions. D.R.Barber

550.3

16409 MAGNETIC MICROPULSATIONS ACCOMPANYING METEOR ACTIVITY. W.H.Campbell.

J. geophys. Res., Vol. 65, No. 8, 2241-5 (Aug., 1960).

Increased activity of magnetic micropulsations with periods of 5 to 30 sec. and magnetic flux densities of 20 to 320 mγ was found to accompany the η Aquarid, δ Aquarid, and Perseid meteor showers in 1958. Conflicting reports are discussed.

550.3

16410 THE GEOMAGNETIC FIELD IN SPACE, RING CURRENTS, AND AURORAL ISOCHASMS.

E.H.Vestine and W.L.Sibley.

J. geophys. Res., Vol. 65, No. 7, 1967-79 (July, 1960).

Using a 48-coefficient spherical harmonic expansion of the geomagnetic field for 1955.0, the results of an analysis due to Finch and Leaton (Monthly Not. Roy, Astron. Soc., Geophys. Suppl., Vol. 7, 314-17, 1957), it is shown that geomagnetic field lines appear to interlink the northern and southern auroral zones. Theoretical age auroral isochasms are also estimated using an integral inv for particle motion along the lines of force and between the nort and southern hemispheres. Some conditions pertinent to simult ity and similarity of the aurora borealis and the aurora australi discussed. Though the auroral zones northern and southern shi latitude with time, in accord with the intensity of magnetic distu ances, the average auroral zone remains a useful parameter in studies. The geographical distribution of isochasms appears to successfully calculated from the geomagnetic field alone and an gral invariant of particle motion. The intersections of particula geomagnetic field lines with the earth's surface in the northern southern hemispheres, or conjugate points, are indicated.

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16411 WORLD-WIDE EFFECTS OF HYDROMAGNETIC WAVES DUE TO ARGUS.

W.K.Berthold, A.K.Harris and H.J.Hope.

J. geophys. Res., Vol. 65, No. 8, 2233-9 (Aug., 1960).

The Argus detonations in the ionosphere above the south At tic produced geomagnetic disturbances that propagated to almos all parts of the world. The geomagnetic variations, having a qu period of 1 to 3 sec were recorded principally by introduction- magnetometers and earth-current stations. Two signals were found whose indicated velocities were of the order of 3000 and 700 km/sec. Amplitudes varied from 5 gammas (Antarctica) do to 0.002 gamma at the large loop in Arizona. The signal streng fell off rapidly as the direction of propagation deviated from the geomagnetic meridian.

550.3 : 52

SOLAR ACTIVITY AND GEOMAGNETIC K-INDEX AT SUNS MINIMUM. See Abstr. 14419

550.3 : 53

COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. See Abstr. 15490

530.3 : 5

16412 GEOPHYSICAL EFFECTS ASSOCIATED WITH THE HIGH-ALTITUDE NUCLEAR EXPLOSION.

H.Uyeda, H.Maeda, A.Kimpara, T.Obayashi, S.Ishikawa and Y.Kawabata.

J.Geomagn. Geoelect., Vol. 11, No. 2, 39-41 (1959).

This is a summarized report on observations and investigat made in Japan up to the present time concerning the geophysical effects associated with the high-altitude nuclear explosions carr out over Johnston Island on August 1 and 12, 1958. The effects c sidered are the geomagnetic disturbances, v.l.f. atmospherics, th field strength of the l.f. waves, the ionosphere, and acoustic and seismic waves. The result of investigations of the associated phenomena indicates the mechanism of generation of each phenomenon to be very complicated and inter-associated. However, in view of the time that elapsed after the blast, there seem to ex three distinct periods. The typical examples are two stages of t magnetic disturbance(s.s.c. and the main phase),and the ionosphe disturbance which appeared several hours later and lasted more than ten hours.

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16413 THE VARIANCE (POWER) SPECTRA OF C_i, K_p, AN

F.W.Ward, Jr.

J. geophys. Res., Vol. 65, No. 8, 2359-73 (Aug., 1960).

Time series of the geomagnetic disturbance indices C_i, K_p, A_p are subjected to variance (power) spectrum analysis. Applica of this technique yields the distribution of the statistical variance a time series as a function of the frequency or period of the variations. Furthermore, its use overcomes certain theoretical computational difficulties inherent in standard Fourier analysis. spectra of the three indices are identical in almost all respects. They demonstrate the mathematical existence of the 6-month per and periods of 27, 14, 9, 7, $5\frac{1}{2}$, and $4\frac{1}{2}$ (27/N, N = 1, 2, 3, 4, 5, and days. No interpretation of the overtones of the 27-day period is given. The spectra show that, over intervals of some months, the are considerable changes in the distribution of the variance amon these periods. However, there are few systematic differences in spectra between times of sunspot maxima and minima.

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

551.5

;414 A BARIUM FLUORIDE FILM HYGROMETER ELEMENT. F.E.Jones and A.Wexler.

eophys. Res., Vol. 65, No. 7, 2087-95 (July, 1960).

An electric hygrometer element which responds rapidly to ges in humidity is described. The relative humidity indication ie element passes through 90% of a total change in indication in c at –20°C and in 8 sec at –40°C. The element consists of a film of barium fluoride deposited over metallic film electrodes glass substrate. The electrical impedance of the element es about 3 orders of magnitude with relative humidity through- the range of 20% to 100% relative humidity at a given tempera- . It can be fabricated reproducibly to conform to mean cali- ion curves. The results of a laboratory study of performance racteristics indicate that the element responds to changes in tive humidity over a wide range of humidities. In the range lied, no upper or lower limits to the operation of the element e found. Hysteresis effects are small. Exposure to high humid- water spray, or water immersion had no permanent harmful ct on the function of the element. Polarization effects are avoided ısing the element only in a.c. circuits. Ageing effects resulting hifts in calibration with time require further study.

551.5 : 533.2

AN AUTOMATIC DEW-POINT HYGROMETER USING PELTIER OLING. See Abstr. 14668

551.5

16415 PRESSURE AND TEMPERATURE EQUALIZATION AT 200-Km ALTITUDE. F.S.Johnson.

geophys. Res., Vol. 65, No. 8, 2227-32 (Aug., 1960).

Atmospheric pressure at 200 km must be nearly constant over entire earth as a result of large-scale air motions which can cur in the ionosphere. In the lower atmosphere, adjacent areas high and low pressure can exist without annhilation by pressure ualization; direct air flow from high to low pressure does not cur, because balanced circulations develop in which inertial rces (centrifugal and Coriolis) balance the pressure forces and event equalization. At altitudes near 200 km, viscous forces event the balanced circulations from occuring, so pressure equa- ation can proceed rapidly. The heat transport associated with air motion is large and tends to bring about temperature equali- tion also. At still higher altitudes, the heat content and the pres- re forces are smaller but the viscous forces for a given velocity ear remain unchanged, making possible the existence of pro- unced high-pressure areas in regions of local heating. The nclusion reached in this study does not permit one to accept the equently held concept that the polar or auroral zone ionosphere much warmer than the equatorial ionosphere with pressures at 0 km several times larger in the polar regions (e.g., at Churchill, nada) than at temperate and low altitudes (e.g., at White Sands, w Mexico).

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16416 INITIAL RESULTS OF THE TIROS 1 METEOROLOGICAL SATELLITE. W.G.Stroud.

geophys. Res., Vol. 65, No. 5, 1643-4 (May, 1960).

Three photographs of cloud cover from about 450 miles itude are given, also brief details of the satellite system and bit.

D.M.Gilbey

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16417 ON THE DETERMINATION OF THE STRUCTURE AND REFRACTIVE INDEX OF THE LOWER TROPOSPHERE OWEST 1000 ft) OVER DUM DUM AIRPORT. A.C.De.

dian J. Meteorol. Geophys., Vol. 10, No. 4, 399-408 (Oct., 1959).

The results of special radiosonde soundings extending up to 00 ft made on certain selected dates and at certain selected hours ring the winter season 1957-58 and pre-monsoon season 1958 over ım Dum airport are discussed. The results indicated the forma- on of ducts at certain hours. The variations of the meteorological ta with the progress of night are shown in a tabular form. The darscope observations at the corresponding hours are also dis- ssed. On some occasions the duct heights were as high as 600 ft d prevailed for the whole night. These ducts extended horizon- lly in all directions to about 50 miles. The attenuation produced by appearance of fog/mist over the station and its masking effect on the ground clutters are also discussed. The mass concentration of water droplets on different dates has been calculated and shown in a tabular form.

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16418 SOME EXPERIMENTS ON THE DETERMINATION OF THE STRUCTURE AND REFRACTIVE INDEX OF THE LOWER TROPOSPHERE (LOWEST 200 ft) OVER DUM DUM AIRPORT, CALCUTTA. A.C.De.

Indian J. Meteorol. Geophys., Vol. 10, No. 3, 295-312 (July, 1959).

The results of low level (lowest 200 ft) radiosonde sounding made on certain selected dates and at certain selected hours during the winter season of 1956-57 and pre-monsoon season of 1957 over Dum Dum airport are discussed. The results show the formation of ducts at certain hours. The variations of the meteorological data with the progress of night are shown in a tabular form. The radarscope observations at the corresponding hours are also discussed. On two occasions in March and April 1957, the duct heights were abnormally high and prevailed for the whole night persisting until or even after sunrise. It is shown that these ducts extended horizontally in all directions to about 60 miles. Some radarscope observations during February-March 1956 are also discussed. On two occasions during February 1956 elevated ducts were noticed. These prevailed for the whole night. The attenuation produced by the appearance of thick fog over the station and its masking effect on the ground clutters are also discussed.

551.5 : 523.4

DENSITY OF NEUTRAL GAS IN A PLANETARY EXOSPHERE. See Abstr. 14398

551.5 : 525

16419 UPPER ATMOSPHERE AND SPACE EXPLORATION WITH ARTIFICIAL SATELLITES. S.K.Mitra.

Science and Culture, Vol. 25, No. 9, 498-511 (March, 1960).

A brief review is given of the progress that has been made in this field.

A.Boksenberg

551.5

16420 LOW-ALTITUDE TESTING OF THE ROCKET-GRENADE EXPERIMENT FOR UPPER ATMOSPHERE TEMPERATURES AND WINDS.

R.F.Stebbings, G.V.Groves, R.L.F.Boyd and P.J.Bowen.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 184-91 (June, 1960).

As a preliminary to the British series of rocket-grenade experiments for determining upper atmosphere temperatures and winds, a number of tenth-scale tests using anti-aircraft shells to simulate grenades were carried out at Shoeburyness in 1956. The objects of these trials were to test the wide-spread array of ground equipment under field conditions, and to check the method of data reduction by comparing the computed temperature and wind results with radio-sonde balloon data. The analysis of sounding data from two night-time trials gave wind speeds which differed in most cases from the balloon values by less than 5 ft/sec. Differences of the order of 10°C in the temperature structures may be reduced by the subsequent inclusion in the method of analysis of second-order acoustic refraction effects.

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16421 DIURNAL VARIATIONS OF DENSITY AND SCALE HEIGHT IN THE UPPER ATMOSPHERE.

J.S.Greenhow and J.E.Hall.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 203-14 (June, 1960).

The radio-echo meteor technique has been used to investigate atmospheric density and scale-height variations between altitudes of 85 and 105 km. A diurnal oscillation of density with an amplitude equal to 13% of the mean density at 96 km is found. The amplitude of this oscillation increases by a factor of 3 over the observed height range. A semi-diurnal density variation approximately half the diurnal oscillation is also present.

551.5 : 537.59

ON THE PROBLEM OF THE NATURE OF SOFT RADIATION IN THE UPPER ATMOSPHERE. See Abstr. 11245

551.5

16422 DISCUSSION OF A PAPER BY F.D.STACEY, "THE POSSIBLE OCCURRENCE OF NEGATIVE NITROGEN IONS IN THE ATMOSPHERE". D.R.Bates.

J. geophys. Res., Vol. 64, No.12, 2469 (Dec., 1959).

A numerical computation is given to show that the concentration of N_2^- is too small to have the effects suggested by Stacey (Abstr. 10400 of 1960). It is assumed that the excess energy ϵ of the ion with respect to the neutral molecule is zero, which is considered to be favourable to Stacey's suggestions. J.Dutton

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16423 AUTHOR'S REPLY TO THE PRECEDING DISCUSSION. F.D.Stacey.

J. geophys. Res., Vol. 64, No. 12, 2470 (Dec., 1959).

It is stated that taking ϵ to be zero (see previous abstract) is not a favourable assumption, because it is equivalent to assuming that N_2 has no electron affinity. Since the concentration depends exponentially on ϵ, Bates' conclusion is thus considered invalid. J.Dutton

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16424 FURTHER DISCUSSION OF PAPER BY F.D.STACEY, "THE POSSIBLE OCCURRENCE OF NEGATIVE NITROGEN IONS IN THE ATMOSPHERE". D.R.Bates.

J. geophys. Res., Vol. 65, No. 5, 1622 (May, 1960).

In the controversy on N_2^- ions (see two previous abstracts) misunderstanding has arisen on the significance of the excess energy, ϵ, of the ion with respect to the normal molecule. The assumption that ϵ is positive does not imply that there are no states in which N_2 has an affinity for an electron. In the case of helium, for example, ϵ is certainly positive, but nevertheless He^- exists. If ϵ for nitrogen were negative N_2^- ions could not be formed and destroyed rapidly in radiationless transitions; and it would be difficult to understand why they have not been detected in the gas phase in the laboratory. Moreover, the arguments which Bates and Massey (1946, 1947) used to show that O^- ions cannot have an appreciable influence on the effective recombination coefficient in the F layers would then be applicable to N_2^- ions.

551.5 : 537.56

A DISCUSSION OF THE MOTION IN NITROGEN OF FREE ELECTRONS WITH SMALL ENERGIES WITH REFERENCE TO THE IONOSPHERE. See Abstr. 14973

551.5

16425 VARIATION OF ELECTRON DENSITY IN THE IONOSPHERE WITH MAGNETIC DIP.

S.Croom, A.Robbins and J.O.Thomas.

Nature (London), Vol. 185, 902-3 (March 26, 1960).

See Abstr. 6465 of 1960. Electron densities N_h for fixed heights h in the F-region, averaged over the ten international quite days of December 1957, for local noon at 17 stations are plotted against magnetic dip (I). A narrow peak at 70° N is found, which is also found in comparable graphs of N_mF_2 versus I. A similar peak in N_mF_2 occurs in the southern hemisphere in winter when the sunspot number is high. Below about 300 km there is no evidence in N_h of the minimum in N_mF_2 which occured at about 50° N in December 1957. D.M.Gilbey

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16426 THE DETERMINATION OF IONOSPHERIC ELECTRON CONTENT BY OBSERVATION OF FARADAY FADING.

W.T.Blackband.

J. geophys. Res., Vol. 65, No. 7, 1987-92 (July, 1960).

From a study of the Faraday fading of signals transmitted from a satellite on 20 of 40 Mc/s the total electron content between satellite and observer can be determined. In special cases a simple interpretation of the records is possible. This method can be applied to the study of the ionosphere above the F_2 maximum. The results of preliminary experiments are presented. A form of satellite transmission is described which would be particularly suitable for such studies.

551.5 : 538.56 : 525

16427 THE USE OF GEOSTATIONARY SATELLITES FOR THE STUDY OF IONOSPHERIC ELECTRON CONTENT AND IONOSPHERIC RADIO-WAVE PROPAGATION.

O.K.Garriott and C.G.Little.

J. geophys. Res., Vol. 65, No. 7, 2025-7 (July, 1960).

Describes a proposed radio propagation experiment utilizing a geostationary satellite. The experimental methods for determining the total electron content of the ionosphere are discussed, and the advantages and capabilities of the methods are summarized. Other possible studies utilizing the satellite transmissions are also outlined.

16428 NEW PRINCIPLE FOR MEASURING IONOSPHERIC ABSORPTION. E.Vassy.

C.R.Acad. Sci. (Paris), Vol. 250, No. 25, 4189-90 (June 20, 196

In French.

Measurements were made of the strength of signals emitte artificial satellites, using a receiving aerial as omnidirectional as possible. Formulae are given for the mean coefficient of absorption in the ionosphere below the satellite. It is claimed the method has advantages over those now in use. D.M.Sc

16429 A STUDY OF 2 Mc/s IONOSPHERIC ABSORPTION MEASUREMENTS AT HIGH LATITUDES. K.Davie

J. geophys. Res., Vol. 65, No. 8, 2285-94 (Aug., 1960).

Ionospheric absorption (L) at high latitudes was studied us the published data on 2.0 Mc/s at five Canadian stations during and 1958. The seasonal and diurnal variations were considere it was found that a pronounced winter anomaly in noon absorptic occured at Churchill but not at Resolute Bay. The diurnal varia indicated that the dependence of absorption on solar zenith angl decreased with increase of latitude. The distribution of midnig absorption with latitude showed that, although the maximum oc in the auroral zone, high absorption is also encountered over th polar cap. A study of the duration of long-lasting blackouts sho that in summer the duration was longer as the latitude increase

16430 THE POLAR RADIO BLACK-OUT OF THE IONOSPHERE OF 7 JULY, 1958. J.H.Chapman.

Canad. J. Phys., Vol. 38, No. 9, 1195-1212 (Sept., 1960).

Ionospheric sounding station data, particularly f-plots, wer used to study the ionospheric storm of 7 July, 1958, which is sh to have consisted clearly of two stages. Polar cap absorption b shortly after an important 3+ flare was observed at 0039 U.T., a a magnetic storm and auroral absorption event followed at 0749 U.T. on July 8. The polar cap absorption spread towards the ge magnetic equator, but the use of higher than first order magneti dipole terms was found necessary in order to arrange the data properly in latitude. The absorption began some hours earlier northern stations than at most southern stations, the main cause the differences in time of onset being thought to be due to the pr ence or absence of sunlight. The inference is drawn that ionosp absorption measured at about 3 Mc/s is caused by ionization at to 80 km heights, in which case the data suggest that electrons f precipitated to the earth above 83° corrected geomagnetic latitu and then protons and helium ions to lower latitudes. The cutoff latitude was 59°, corresponding to a particle magnetic rigidity of 9.6×10^8 eV/c. This storm was compared with the more severe event of 23 February, 1956, and showed to be of a similar nature

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16431 GYRO-FREQUENCY IN THE IONOSPHERIC REGION

S.Datta and R.N.Datta.

Indian J. Phys., Vol. 33, No. 7, 316-24 (July, 1959).

Gyro-frequencies in the E, F1 and F2 regions of the ionosph over Haringhata (geographic lat. 22.9° N, geomag. lat. 12.5° N) h been calculated from the measurements of ordinary (f_o) and extr ordinary (f_x) critical frequencies. It is found that the calculated magnetic fields are higher than those expected from extrapolatio of the magnetic field at ground-level to the heights of the regions inverse cube law. Further, the E region gyro-frequency has a marked semi-diurnal variation with a minimum near midday. T result is similar to that obtained by Scott at high latitudes (Abstr 6633 of 1951). No diurnal variation is found in the F1 and F2 reg though, the values near midday in the F1 region are lower. Poss causes of the E-region gyro-frequency variation are discussed. satisfactory explanation is, however, obtainable. In the F2 regio the average winter value of the gyro-frequency is found to be abo 9% greater than the summer value. Seasonal variation, though of larger magnitude (20%), has also been obtained by Scott at high latitudes (Abstr. 1203 of 1950). The frequency difference $(f_x - f_o)$ found to be dependent on the ordinary critical frequency (f_o), the values at high frequency being lower than those at lower frequenc This is to be expected for the case of quasi-transverse propagati

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16432 IONOSPHERIC BACKSCATTER OBSERVATION AT 440 Mc/s.

V.C.Pineo, L.G.Kraft and H.W.Briscoe.

J. geophys. Res., Vol. 65, No. 5, 1620-1 (May, 1960).

Plots of signal-to-noise ratio (+1 to −22 dB) versus height o 800 km) of the backscattering electrons are given for vertical ence and for 15° elevation, together with a frequency spectrum backscatter. The change of range with elevation is as expected, e spectrum width (11 kc/s at half-power level) is 5-10% of that cted by Gordon (Abstr. 554 B of 1959; Proc. Inst. Radio Engrs, 46, No. 11, 1824-9, Nov., 1958). It is planned to estimate the pheric electron density profile to above 800 km, and to determine ltitude dependence of the spectrum width. D.M.Gilbey

551.5

6433 DYNAMIC CHARACTERISTICS OF THE IONOSPHERE AND THEIR COHERENCY WITH THE LOCAL AND NETARY MAGNETIC INDEX. K.Bibl.

ophys.Res., Vol. 65, No. 8, 2333-42 (Aug., 1960).

With some new definitions, dynamic parameters of the ionosphere be obtained from direct recordings of ionospheric characteristics. parameters were adopted and evaluated every day in 1959. se parameters were used to detect some relations existing een the intensity of sporadic E ionization, the movement of the nization, and the magnetic character figures, both local and etary. Quiet days as defined from ionospheric parameters were more frequent than disturbed ones. The following results were ined by the method of partial correlation; (1) when E_s ionization ars there are at the same time important height fluctuations of F ionization. With an intense E_s the F ionization is blown up to ater altitudes additionally. A good correlation exists between the nsity of E_s ionization and the amplitude of the height fluctuations ionization; (2) the fluctuations of the terrestrial magnetic field also correlated with those of the F ionization which are produced bout the same time; the amplitude of the fluctuations of the F zation increases monotonically with the intensity of magnetic vity; (3) E_s ionization has a "calming" effect on the magnetic field; ecreases fluctuations. This is assumed to be a local screening ct of the E_s layer. The high correlation between local and etary magnetic perturbations could be explained by the relations sting between these two parameters and the height fluctuations of nization. Until now simple correlations have in general been culated considering only one ionospheric and one magnetic ameter. The effects of E_s on the one hand and height fluctuations ionization on the other have been separated by the method of tial correlation.

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16434 ANISOTROPIC FIELD-ALIGNED IONIZATION IRREGULARITIES IN THE IONOSPHERE NEAR THE GNETIC EQUATOR. R.D.Egan.

geophys. Res., Vol. 65, No. 8, 2343-58 (Aug., 1960).

During the 1958-1959 International Geophysical Year, a three-quency, swept-azimuth backscatter sounder was operated at ancayo, Peru. An unusual echo, which has been shown to be due the presence of field-aligned ionization irregularities in the osphere, was discovered early in the programme. These atorial scatter echoes (EqS) are observed on over 90% of the days 18 and 30 Mc/s) and exhibit a diurnal variation very similar to t of the equatorial electrojet. By means of the backscatter pulse servations, in conjunction with the Booker theory of backscattering m anisotropic field-aligned irregularities, it has been possible to ermine the size and extent of the scattering region. The E-region oes originate at heights between 100 and 140 km. At times, wever, the upper limit may extend to 200 km or more. F-region oes have occasionally been observed which appear to originate heights corresponding to the maximum ionization density of the er. Observations of the strength of the EqS echoes indicate that mean square fractional deviation of the electron density $(\overline{\Delta N/N^2})$ is ween 10^{-3} and 10^{-5}. The discovery of the presence of equatorial ld-aligned ionization irregularities has made it possible for the st time to describe adequately a number of equatorial ionospheric nomena, including the mechanism of "equatorial-type" sporadic E.

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16435 ENHANCED IONIZATION IN THE POLAR IONOSPHERE ASSOCIATED WITH GEOMAGNETIC STORMS.

Obayashi and Y.Hakura.

atmos. terrest. Phys., Vol. 18, No. 2-3, 101-22 (June, 1960).

New evidence indicating the existence of energetic solar parti-s associated with solar flares has been found from the analysis of rld-wide data of f_{min} in the ionograms. An outstanding enhance-nt of ionization in the lower ionosphere occurs in the polar region h the delay of several hours after a large solar flare accompanied major radio outbursts of type IV. Radio blackouts due to en-nced ionizations develop, spreading inside the whole polar cap without inducing any marked geomagnetic activity. With the onset of a geomagnetic storm, however, the blackout region spreads from the polar cap up to the so-called auroral zone. As the D_{st} field of geomagnetic storm develops, it comes down to considerably low latitudes forming a spiral-shaped ionization pattern. The radio blackouts, which precede the onset of geomagnetic storms, may be termed the polar cap blackouts because they are confined within the geomagnetic latitude of about 60 ~ 65°, while those related to geomagnetic storms and auroral displays are the auroral zone blackouts. It is shown that the polar cap blackouts are caused by the invasion of energetic particles of the order of 10 ~ 100 MeV, generated in an agitated solar coronal plasma bearing magnetic fields, and that those particles precipitate on the polar ionosphere following nearly the Störmer orbits. For the auroral zone blackouts, an improved version of the Störmer theory is applied, in which an interesting behaviour of a charged particle in the distorted geomagnetic field is revealed. The remarkable equatorward shifting of the auroral zone and some peculiar increases of cosmic ray intensity during the main phase of magnetic storms are explained consistently by the decrease of geomagnetic cut-off for incoming particles owing to the contraction of the geomagnetic cavity.

551.5

16436 TRUE HEIGHT DETERMINATIONS OF IONIZATION AT HIGH LATITUDES. D.Lepechinsky and C.Taieb.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 152-9 (June, 1960). In French.

The z-trace which often appears on ionograms of high latitude stations is usually much better defined than the o-trace, the latter being rather diffuse. True height determinations, including the earth's magnetic field now in use, being all based on the o-trace, a new matrix method is proposed similar to that of Budden (Abstr. 5784 of 1955) but applicable to the z-trace. The appropriate matrix has been calculated (for f_H = 1.8 Mc/s) for frequencies up to 6 Mc/s and the results of a profile determination is presented involving both "o" and z-matrix methods for a typical Terre Adelie ionogram.

551.5

16437 INCOHERENCY OF PULSE ECHOES AND THE MEASUREMENT OF IONOSPHERIC ABSORPTION.

J.Taubenheim.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 147-51 (June, 1960).

The presence of incoherently scattered energy in the h.f. pulse echoes from the ionosphere gives rise to errors in the absorption value determined from the median echo amplitude. These errors are larger for the second-order than for the first-order echo. The calculations are confirmed by experimental results.

551.5

16438 HYDROMAGNETIC WAVE PROPAGATION IN THE IONOSPHERE. J.A.Fejer.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 135-46 (June, 1960).

The dispersion equation of hydromagnetic waves, including the effects of collisions, is obtained for an arbitrary angle between the direction of propagation and the direction of a primary magnetic field, assuming certain approximations usually valid in the terrestrial ionosphere. Special cases of the general dispersion equation are considered and some well-known results are regained. Expressions for the dissipated power are derived. The propagation of hydromagnetic waves in a horizontally-stratified ionosphere is discussed, by analogy with the propagation of very-low-frequency radio waves.

551.5

16439 ON THE IONOSPHERIC HEATING BY HYDROMAGNETIC WAVES CONNECTED WITH GEOMAGNETIC MICRO-PULSATIONS. S.Akasofu.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 160-73 (June, 1960).

The energy dissipation process of the hydromagnetic waves in the ionosphere is studied in detail. It is shown that their heat production and the resulting increase of temperature are negligible.

551.5

16440 A THEORY OF IONOSPHERIC CURRENTS ASSOCIATED WITH AURORAE. I. J.T.Weaver and R.Skinner.

Canad. J. Phys., Vol. 38, No. 8, 1089-1103 (Aug., 1960).

The current distributions induced by dynamo action in a sheet of partially ionized gas moving with uniform velocity across a perpendicular magnetic field are derived for the case when the gas contains an elliptical region of greater ionization density. Special attention is paid to processes occurring away from the ends of a long narrow ellipse in which the ionization density is much greater than the surrounding region. The results are discussed in relationship to conditions pertaining in the ionosphere when a long homogeneous auroral arc is present. It is concluded that a line current, whose magnitude is linearly dependent on the height-integrated Cowling conductivity within the arc, flows along the arc.

551.5

16441 A THEORY OF IONOSPHERIC CURRENTS ASSOCIATED WITH AURORAE. II. J.T.Weaver and R.Skinner.

Canad. J. Phys., Vol. 38, No. 8, 1104-13 (Aug., 1960).

The average ionospheric current flowing along a long homogeneous arc, is calculated numerically on the basis of the theory developed in the preceding Abstract. This is compared with the auroral current necessary to produce the observed magnetic disturbance at Saskatoon (52.1°N, 106.6°W) and Flin Flon (54.7°N, 102.0°W) for an arc which satisfies the conditions required by the theory. A good order of magnitude agreement between the two values is obtained. The theory also shows that, in general, the magnitude of the line current is proportional to the intensity of the arc, but that when the ionospheric wind is directed along the arc, the line current vanishes. Thus a simple explanation of the occurrence of arcs with no associated magnetic disturbance is provided. A relationship between the average magnetic disturbance due to arcs and the ionospheric wind velocity is also established. The hourly variation of magnetic disturbance during aurorally active hours at Saskatoon and Flin Flon is shown to predict ionospheric wind velocity variations which agree well with those obtained by radio measurements.

551.5 : 538.56

THE REFRACTION OF RADIO WAVES BY A SPHERICAL IONIZED LAYER. See Abstr. 15158

551.5

16442 DIURNAL VARIATION OF THE ELECTRON DISTRIBUTION IN THE IONOSPHERIC E-LAYER.

B.J.Robinson.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 215-33 (June, 1960).

By means of a special sounder h'(f) curves have been obtained with an accuracy sufficient to determine the distribution of the ionization in the E-layer. The variation of the scale height in the E-region has been deduced from the shape of the layer. The diurnal variation of the ionization has yielded an estimate of the recombination coefficient. It is shown that there may be vertical drift effects comparable with the effects of recombination. The results determined from the layer shapes are compared with the information provided by accurate penetration-frequency measurements.

551.5 : 538.56

SUDDEN CHANGES IN THE VIRTUAL HEIGHT OF RADIO WAVES REFLECTED FROM THE E-REGION OF THE IONOSPHERE. See Abstr. 15170

551.5

16443 SUNRISE EFFECT IN THE F REGION OF THE IONOSPHERE OVER KODAIKANAL. V.R.Venugopal.

Indian J. Meteorol. Geophys., Vol. 10, No. 3, 325-30 (July, 1959).

It is found that the effect occurs about an hour after the moment of sunrise for visible rays in the layer and a few minutes before ground sunrise. This result is compared with those obtained at other places. The delay in the occurrence of the sunrise effect is believed to be due to the absorption of the solar ionizing radiation by the ionospheric layers lying to the east of the observing station.

551.5

16444 TEMPERATURE OF THE F REGION OF THE IONOSPHERE OVER KODAIKANAL. V.R.Venugopal.

Indian J. Meteorol. Geophys., Vol. 11, No. 2, 171-5 (April, 1960).

Night temperature of the F region of the ionosphere over Kodaikanal has been computed by the scale height method for the months of June and December. The temperature at a height of 300 km is found to be round about 1200°K. It is also observed that winter temperatures are higher than summer temperatures. This summer to winter warming up may be due to the winds in the ionosphere.

551.5

16445 CORRECTION TO THE PAPER, "THE HEIGHT OF F-LAYER IRREGULARITIES IN THE ARCTIC IONOSPHERE". H.F.Bates.

J. geophys. Res., Vol. 65, No. 4, 1304 (April, 1960).

See Abstr. 10422 of 1960. The actual heights (350-500 km) previously attributed to the observed F-region irregularities are
amended to 250-400 km. The assumptions (i) that the least-tim
path passes close to the layer maximum, and (ii) that the prese
of the E-layer does not affect the virtual height of the base of th
F-layer, invalidate the first estimates. D.M.G

16446 ANOMALOUS f_0F_2 VARIATIONS IN THE ANTARCTI G.E.Hill.

J. geophys. Res., Vol. 65, No. 7, 2011-23 (July, 1960).

The daytime minimum in the F_2-layer critical frequency, w
is often observed in the Antarctic, is explained on the basis of a
vertical shear in the horizontal wind (neutral air) and the result
movement of charged particles in the presence of the earth's m
netic field. The diurnal variation of the F_2-layer critical freque
as expressed by the noon minus the midnight value, D, is norm
positive, but in the case of the daytime minimum is negative. F
a given month, the value of D was found to depend upon both the
graphic latitude and geomagnetic dip. The D values from the n
ern hemisphere were compared with the D values of the souther
hemisphere for a time separation of 6 months. The comparison
gave good agreement in the region of the graphs where there we
stations for both hemispheres. (Owing to the asymmetry of the
magnetic field, several stations in the southern hemisphere are
found to have no corresponding stations in the northern hemisph
on the basis of geographic latitude and geomagnetic dip). It was
also noted that the negative D values occurred almost entirely i
the southern hemisphere and in that region where there are no
corresponding northern hemisphere stations. A three-level moc
of the F region was developed for the purpose of demonstrating
effect of a vertical wind shear on the electron concentration. Th
results of electron-density computations for several cases show
that the characteristic F_2-layer critical-frequency variations ca
explained on the basis of a wind shear of the order of 25 to 50 m
per 100 km. The wind shear can account for most of the "anoma
behaviour in the Antarctic.

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16447 PHOTOCHEMICAL RATES IN THE EQUATORIAL F_2 REGION FROM THE 1958 ECLIPSE.

T.E.Van Zandt, R.B.Norton and G.H.Stonehocker.

J. geophys. Res., Vol. 65, No. 7, 2003-9 (July, 1960).

The F_2-region electron-density data from the eclipse on
October 12, 1958, at Danger Islands has been analysed by a new
method. It is shown that (1) temperature changes and transport
electrons were probably negligible during the eclipse, and (2) the
rate of photoionization q(h) and the linear recombination coeffici
("attachment coefficient") β(h) can be approximated between 290
and 400 km by

$$q(h) = 800 \exp[-(h-300)/186] \text{ electrons cm}^{-3} \text{ sec}^{-1}$$

$$\beta(h) = 6.8 \times 10^{-4} \exp[-(h-300)/103] \text{ sec}^{-1}$$

where the height h is measured in kilometres. The rate of form
tion of ion pairs between 290 and 400 km is $(0.76)10^{10}$ ion
pairs/cm^2 sec, or about (0.25) ergs/cm^2 sec. This implies a tota
rate of energy absorption in the F region of at least 2 ergs/cm^2

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16448 IONOSPHERIC OBSERVATIONS ON THE F-REGION DURING THE SOLAR ECLIPSE OF 19 APRIL, 1958.

S.Datta, P.Bandyopadhyay and R.N.Datta.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 182-5 (Oct., 1959).

A description of observations made at Haringhata (23°N), wh
the maximum area of the sun's disk obscured was 61%. A dip wa
observed in both peak electron density of the F2-layer and total
electron content of the F-region, as compared with control days.
variation of the height of the F2-peak and the behaviour of the F1
region were also studied. D.M.Schl

55

16449 THEORY OF SPREAD F BASED ON ASPECT-SENSITIVE BACKSCATTERED ECHOES. J.Renau.

J. geophys. Res., Vol. 65, No. 8, 2269-77 (Aug., 1960).

To explain spread echoes from the F region the concept of as
sensitivity was incorporated in derivations of h'f curves using the
assumption that the magnetionic components can be treated separ
The shape of the h'f curves, as well as the extent of range and
frequency spreading, was deduced for ionospheric stations locate
various magnetic latitudes. The requirements of aspect sensitivi
restrict the solid angle containing the echo rays to a wedge with i
apex line running east-west through the transmitter location and

gle determined by the dip angle. At the magnetic north the
opens flat, and at the magnetic equator the wedge degenerates
n east-west flat fan. The model does not lead to an explanation
arge class of observed spread F in the northern and middle
des. At the magnetic equator, however, the model is potentially
le of clarifying the observed spread F of a type shown in this
p.

551.5

450 THE EFFECTS OF DIFFUSION AND OF ATTACHMENT-LIKE RECOMBINATION ON THE F_2 REGION.
.Gliddon and P.C.Kendall.
ophys. Res., Vol. 65, No. 8, 2279-83 (Aug., 1960).

Jsing formulas developed in a previous paper; Gliddon and
all (see Abstr. 14243 of 1960), quantitative results for the diurnal
tion of electron density in the F_2 region have been obtained,
g account of diffusion and of an exponentially decreasing
hment-type law of recombination. The atmosphere is assumed
isothermal, and for the case considered (middle latitude) the
t of the geomagnetic field on diffusion is small enough to be
ed.

551.5

6451 THE EQUATORIAL F-REGION OF THE IONOSPHERE. R.A.Duncan.
mos. terrest. Phys., Vol. 18, No. 2-3, 89-100 (June, 1960).

A comparison of data from ionospheric sounders at Chimbote
Panama, shows that afternoon critical frequencies in the equatorial
are negatively correlated with those on the same meridian in
sub-tropical belts. This supports Martyn's suggestion that ioni-
on is transported from the equatorial zone to the sub-tropics.
process suggested by Martyn, electrodynamic lift at the equator
wed by diffusion under gravity along the geomagnetic field lines
e sub-tropical belts, is investigated quantitatively, and it is
wn that the process can account for the high sub-tropical electron
sities observed. It is shown that the diurnal variation of the
relation between Chimbote and Panama critical frequencies, the
nal variation of electron density enhancement in the sub-tropics,
all be ascribed to the simple diurnal electrodynamic tide expec-
from the observed magnetic variations, in conjunction with dif-
on along the geomagnetic field lines.

551.5

16452 ELECTRON DISTRIBUTION IN THE F-LAYER OF THE IONOSPHERE OVER HARINGHATA (CALCUTTA) ON
ET AND DISTURBED DAYS. P.Bandyopadhyay.
tmos. terrest. Phys., Vol. 18, No. 2-3, 127-34 (June, 1960).

Presents the results of a study of the behaviour of the F-layer
he ionosphere over Haringhata (Calcutta) on quiet and disturbed
s. The study is made from "mean quite F-layers" and "mean
turbed F-layers" constructed for this place following the method
he Cambridge group of workers (Abstr. 7869-70 of 1956). The
et-day results are further examined with a view to verifying the
del of the coefficient of electron loss in the layer. as derived by
above workers.

551.5

16453 EQUILIBRIUM ELECTRON DISTRIBUTIONS IN THE IONOSPHERIC F2-LAYER. H.Rishbeth and D.W.Barron.
tmos. terrest. Phys., Vol. 18, No. 2-3, 234-52 (1960).

In the F-region of the ionosphere, the electron density is
trolled by the production of ionization by solar radiation, loss by
ombination, and transport of ionization by electromagnetic drift
vements and plasma diffusion. The factors which govern the
peak of electron density are discussed in detail. An electronic
puter has been used to solve the relevant equations for conditions
quilibrium, such as may be approached in the day-time F-region.
m the numerous examples considered, it is deduced that the
imum electron density, and the height at which it occurs, are
h that the magnitudes of the production, loss and diffusion
cesses are approximately equal. The modifications produced by
tical electromagnetic drifts are discussed. Most of the work
ated to the simple case of an isothermal atmosphere, but the
clusions derived are found to be substantially true for a few more
eral models which have been considered.

551.5

16454 THE GEOGRAPHICAL DISTRIBUTION OF IONIZATION IN THE F2-LAYER. C.M.Minnis and G.H.Bazzard.
atmos. terrest. Phys., Vol. 18, No. 2-3, 181-3 (June, 1960).

For any location the monthly mean F2-layer critical frequency, fF2, can be expressed as a family of linear functions of an ionospheric index of solar activity. The intercepts of these functions have been determined for sixty-five locations at noon and form a reliable tool for investigating the geographical distribution of fF2 at minimum solar activity. It has been found that the equatorial trough in fF2 cannot be conclusively proved to exist in the western hemisphere at certain times of the year.

551.5 : 621.391.812.63

16455 THE SIZE OF THE MOVING IRREGULARITIES IN THE F-REGION AND THE SPREAD ANGLE OF THE RADIO WAVES SCATTERED FROM THEM. S.R.Khastgir and R.N.Singh.
J. atmos. terrest. Phys., Vol. 18, No. 2-3, 123-6 (June, 1960).

The three-spaced-receiver fading records of the F-echo at 3.8 Mc/s, taken at Banaras during the period from November 1956 to September 1958 show certain characteristic patterns. The fading patterns which were considered as due entirely to the movement of large ionospheric irregularities are analysed by the method of Briggs and Phillips (Abstr. 767 of 1951). As a result of this analysis the average characteristic length of the irregularities is found to be 270 m and the average angular spread is found to be 6°. The variations of these parameters are shown with the help of histograms. The records show some diurnal and seasonal variations, but no definite conclusion can be made regarding such variations.

551.5 : 523.72

16456 COUPLING OF THE SOLAR WIND AND THE EXOSPHERE. C.P.Sonett.
Phys. Rev. Letters, Vol. 5, No. 2, 46-8 (July 15, 1960).

Additional evidence for a solar wind is obtained as the result of two rocket magnetometer experiments carried out at altitudes greater than 14 earth radii. A possible resolution is suggested of the apparent inconsistency of the boundary distance obtained from these experiments as compared to the figure based upon comet observations.

A.Boksenberg

551.5 : 537.59

16457 STAR PRODUCTION BY TRAPPED PROTONS IN THE INNER RADIATION BELT. H.Yagoda.
Phys. Rev. Letters, Vol. 5, No. 1, 17-18 (July 1, 1960).

The rate of star production by trapped radiation, in a rocket-borne block of Ilford G5 emulsion at an average altitude of 1100 ± 60 km, is found to be 297 000 ± 15 000 cm^{-3} day^{-1}, of which 78% are directly attributable to a proton primary. Measurements on 107 p-stars are compared with the trapped proton energy spectrum deduced by Freden and White (Abstr. 12903 of 1959).

A.Boksenberg

551.5

16458 FIELD-ALIGNED IONIZATION. J.Mawdsley and W.H.Ward.
J. geophys. Res., Vol. 65, No. 6, 1828-30 (June, 1960).

It is suggested that leakage from the horns of the inner Van Allen radiation belt may be responsible for ionization in E and F regions aligned with the earth's magnetic field in middle latitudes. It may thus be the cause of aspect-sensitive echoes scattered from region E and also the cause of spread-F and radio-star scintillations.

D.M.Schlapp

551.5

16459 MEASUREMENT OF THE NEUTRON FLUX IN SPACE. W.N.Hess and A.J.Starnes.
Phys. Rev. Letters, Vol. 5, No. 2, 48-50 (July 15, 1960).

The flux and energy spectrum of neutrons leaking out of the top of the atmosphere has been calculated (Hess, Canfield and Lingenfelter, J.Geophys. Res. to be published) and should be the principal source of neutrons in space close to the earth. To check these calculations, and to determine whether there are any other important sources of neutrons in space, a $B^{10}F_3$ neutron detector was flown on an Atlas rocket to 1400 km. The results seem to show good agreement with the calculations and therefore suggest that other sources of neutrons in space near to the earth are substantially smaller than the atmospheric leakage source.

A.Boksenberg

551.5

16460 AN ATTEMPT TO DETECT ENERGETIC GAMMA RADIATION FROM THE SUN. R.E.Danielson.
J. geophys. Res., Vol. 65, No. 7, 2055-9 (July, 1960).

A γ-ray telescope was constructed to detect solar γ-rays with energies greater than about 200 MeV. This telescope was manually operated during a Stratolab flight for about 40 minutes. An upper limit to the flux of γ radiation from the sun during this time was found to be 0.008 photon/cm^{2}sec. This is roughly 1% of the cosmic-ray flux.

551.5

16461 THEORY OF AURORAL STRUCTURES.
E.R.Harrison.

Nature (London), Vol. 187, 383-6 (July 30, 1960).

Electromagnetic theory, combined with the equations of motion and continuity, is used to investigate the properties of a density-modulated plasma beam in a magnetic field. It is shown that a stable beam is possible provided that its cross-section is sufficiently thin. Such beams will be guided rigidly along the geomagnetic lines of force to produce quiescent auroral arcs and rays. Elementary conditions needed for the production of stable beams are discussed. It is demonstrated that as the plasma density in the beam increases the arc beam tends to instability with a resultant loss of beam energy. Interactions in the beam caused by electrostatic oscillations can lead also to bunching of the density modulation, with a rapid loss of beam momentum. D.R.Barber

551.5

16462 COLOUR PHOTOGRAPHY OF THE AURORA.
M.Gadsden.

J. atmos. terrest. Phys., Vol. 17, No. 4, 347-9 (Feb., 1960).

Modern colour films of the three layer subtractive type are shown to have spectral sensitivities and speeds which make them suitable for auroral investigations. An example of the results attainable is given. N.Murcott

551.5

16463 LINE WIDTH OF O I 5577 OF THE NIGHT SKY AND OF AURORAE.
E.B.Armstrong.

J. Phys. Radium, Vol. 19, No. 3, 358-65 (March, 1958). In French.

Observations of the O I green line profiles in the airglow and aurorae, made with a photoelectric Fabry—Perot interferometer, are described. The temperature of the region emitting the airglow radiation appears to be between 180°K and 220°K, the most likely value indicated being 190°K. Auroral regions emitting the green line appear to range in temperature from 255°K to 540°K. A method of estimating line widths from fringes in the presence of background light is described.

551.5

16464 MOVEMENT OF AURORAL IONIZATION.
J.Mawdsley.

J. geophys. Res., Vol. 65, No. 6, 1825-7 (June, 1960).

The disagreement which Leadabrand et al. (Abstr. 10442 of 1960) find between their measurements of movements of auroral ionization and those of other workers, e.g. Bullough et al. (Abstr. 797 of 1960), may be due to a difference in behaviour between auroral and lower latitudes, rather than between higher and lower frequencies, as suggested by Leadabrand et al. D.M.Schlapp

551.5 : 523.16

16465 EFFECT OF LINE-OF-SIGHT AURORA ON RADIO STAR SCINTILLATIONS.
R.F.Benson.

J. geophys. Res., Vol. 65, No. 7, 1981-5 (July, 1960).

Evidence is presented to show that active auroral forms that pass across the line of sight to a radio star can have a direct effect on the scintillations of the signal received on a frequency of 223 Mc/s. This effect is most pronounced if the level of scintillation activity is relatively low before the aurora crosses the star position. Two examples are presented: in the first, an intense auroral band between the radio source in Cassiopeia (angular diameter, 4') and the receiver disrupts the characteristic sinusoidal trace produced by the radio star signal in the output of the phase switch interferometer. This long-duration fade lasted for a period of about 8 min. In the second example, the aurora is accompanied by strong angular scintillation coincident with strong absorption of 27.6 Mc/s galactic radio waves. In both examples the radio star was within 10° of the geomagnetic zenith.

551.5 : 621.391.812.624

16466 THE SCATTERING OF 36 Mc/s RADIO WAVES BY WEAK AURORAL IONIZATION.
J.S.Greenhow, E.L.Neufeld and C.D.Watkins.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 174-80 (June, 1960).

Some observations of weak back-scatter echoes similar in type to the echoes associated with visual aurorae are described. With an equipment of high sensitivity at a frequency of 36 Mc/s, these e are present to the north of Jodrell Bank, (lat. 53°N, geographic lat. 56°N, geomagnetic), for up to 30% of the observing time. Th irregularities in ionization, which are aligned along the earth's netic field, have a length scale of 160 m and a scattering polar gram with a width of approximately ±3°. The horizontal dimens of the ionized regions are about 500 km along parallels of geom netic latitude, and 50 km at right angles to this direction. Echo from horizontal layers of ionization, associated with the field a irregularities, are also observed.

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16467 SIMULTANEOUS V.H.F. AURORAL BACKSCATTE MEASUREMENTS.
W.A.Flood.

J. geophys. Res., Vol. 65, No. 8, 2261-8 (Aug., 1960).

Simultaneous auroral echoes at 49.7, 143.5, and 226 Mc/s have been recorded using scaled radar equipments. Analysis indicates that the wavelength dependence of auroral echoes var from $\lambda^{3.5}$ for frequencies of 49.7 and 143.5 Mc/s to $\lambda^{6.5}$ for frequencies of 143.5 and 226 Mc/s. These measurements are in reasonable agreement with Booker's theory (Abstr. 8531 of 195 auroral echoes if the scale sizes (measured transverse to the ma field) are taken as roughly 40 cm. Evidence for nondeviative abso at 50 Mc/s is also adduced.

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16468 41 Mc/s I.G.Y. AURORAL RADAR AT ITHACA, NEW YORK.
C.W.Gartlein, G.Sprague and R.C.Wa

J. geophys. Res., Vol. 65, No. 8, 2255-9 (Aug., 1960).

The I.G.Y. records taken on the 41 Mc/s auroral radar at Ithaca have been compared with visual observations. It appears that the radar consistently detects auroras between 500 and 120 north of Ithaca and can therefore be used to study auroral statis in this region. Specific studies have been made of the latitude distribution and the diurnal distribution. Many unidentified, non auroral echoes are present.

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16469 NIGHT-SKY SPECTROSCOPY IN THE INFRARED B MEANS OF FOURIER TRANSFORMATION.
J.Connes and H.P.Gush.

J. Phys. Radium, Vol. 20, No. 11, 915-17 (Nov., 1959). In Frenc

Intensity measurements in the spectrum of the night airglow were made at high resolution on 7 March 1959 in the wavelength range 1.47-1.80 μ, using an interferometric method in which the spectrum was detected photoelectrically, and recorded as the Fourier transform of the resultant interferogram. The method, applied to the infrared region of the night airglow, has the advan of giving superior resolution combined with a much higher signa noise ratio than is possible with classical methods. D.R.Ba

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16470 A NEW METHOD FOR THE STUDY OF THE LIGHT THE NIGHT SKY.
G.Guilino and H.Maier-Leibnitz.

J. Phys. Radium, Vol. 19, No. 3, 270-2 (March, 1958). In French

A monochromator is described that produces modulated ligh by interference fringes of a spectral line, whereas the continuou background is not modulated. No correction is needed for the ba ground and the apparatus is capable of registering faint and exte light sources.

551.5 : 53

16471 A RECORDING FABRY—PEROT INTERFEROMETE FOR THE STUDY OF THE GREEN NIGHT-SKY LINE
N.Allard.

J. Phys. Radium, Vol. 19, No. 3, 340-1 (March, 1958). In French

A photoelectric Fabry—Perot spectrometer was used and a description of the interferometer is given. Use of an easily port device for the purpose of observing the width of the ($^3_2[O_1]$ 5577 A in different stations is described.

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16472 RESONANCE SCATTERING BY ATMOSPHERIC SODIUM. VIII. AN IMPROVED METHOD OF DEDUCING THE VERTICAL DISTRIBUTION.
D.M.Hunten.

J. atmos. terrest. Phys., Vol. 17, No. 4, 295-301 (Feb., 1960).

For Pt VII see Abstr. 14287 of 1960. It is shown that the derivative of sodium twilight brightness with shadow height may be r garded as a smeared version of the vertical distribution of sodiu atoms. The distribution may be recovered by use of the chord c struction of Bracewell (Abstr. 9540 of 1955). The method is test

odel distribution and found satisfactory; it is easier to use
ves more detail than the matrix method previously proposed.
he sodium abundance is large, the derivative curve must be
ted for resonance absorption before it can be used. A simple
d of doing this is described and the required numbers tabulated.

551.5

73 FORMATION OF RAINBOWS IN A VERTICALLY PROJECTED SEARCHLIGHT BEAM.

nthakrishnan and S.P.Venkiteshwaran.
J. Meteorol. Geophys., Vol 10, No. 4, 456-9 (Oct., 1959).

bservations of the searchlight beam on nights when light or
ate rain was falling have revealed two bright bands of which
per one is brighter than the lower. Both these bands reveal
al colours. The space between these two bands is compara-
dark. From the geometry of the problem it is clear that
the secondary bow appears at a higher elevation than the
ry bow in the case of natural rainbows formed when sunlight
racted by falling raindrops at a distance, the primary bow has
er angular elevation than the secondary when these are formed
vertically projected beam of searchlight.

551.5

474 ATMOSPHERIC SCINTILLATION OBSERVED WITH CENTIMETRIC WAVES. J.Arsac.

Astrophys., Vol. 22, No. 5, 447-67 (1959). In French.

Simplified theory, using first order developments, of the
illation in a wholly inhomogeneous atmosphere. The result is
od agreement with experimental results obtained in optics or
ntimetric radiowaves. In the centimetre region, the observed
lts do not allow information to be obtained on the statistical
erties of the fluctuations of the refractive index in the atmosphere.

551.5 : 523.16

THE SIMULTANEOUS OBSERVATION OF RADIO STAR TILLATIONS ON DIFFERENT RADIO-FREQUENCIES.

Abstr. 14385

551.5

475 SCINTILLATION, SPREAD F, AND TRANSEQUATORIAL SCATTER. J.R.Koster and R.W.Wright.

ophys. Res., Vol. 65, No. 8, 2303-6 (Aug., 1960).

Radio-star scintillation of great intensity are a common
rrence at the equator. Near the minimum of sunspot activity
exhibit little dependence on magnetic activity, but as sunspot
imum approaches there is a marked negative correlation
een the occurrence of scintillation and the degree of magnetic
rbance. Radio-star scintillation is found to be much greater
nspot maximum than at sunspot minimum.

551.5 : 621.317.39

6476 PROBLEMS ASSOCIATED WITH PRECISE DETERMINATION OF THE INDEX OF REFRACTION OF THE RTH'S ATMOSPHERE. A.M.Bush.

E. Trans Instrumentation, Vol. I-9, No. 1, 23-8 (June, 1960).

In the aerial electronic geodetic surveying programme being
ducted by the U.S. Air Force, accuracies in electronic distance
surement of the order of 10 feet in 200 miles are desired. To
in such accuracy, a knowledge of the speed of propagation along
signal path is essential. The speed of propagation can be deter-
ed from a knowledge of the index of refraction of the atmosphere.
index of refraction of the atmosphere is not constant, but varies
in the range 1.000000 to 1.000400 as a function of position and
; in may thus be considered as a time-varying scalar field. As
many fields, adequate representation of the index of refraction
function of time and position is not, as yet, possible. The
roach taken is to assume that the field is horizontally stratified,
is, that space variation is restricted to the vertical direction,
to ignore time variation. This representation is then used over
nited area and for a limited time after measurements are made.
paper is a statement of the problems involved in obtaining the
esentation of the index of refraction, followed by a description
n ideal method of measurement, two approaches to this ideal,
the method now being used.

551.5

6477 POWER SPECTRA OF TEMPERATURE, HUMIDITY AND REFRACTIVE INDEX FROM AIRCRAFT AND THERED BALLOON MEASUREMENTS. E.E.Gossard.

E. Trans Antennas and Propagation, Vol. AP-8, No. 2, 186-201
rch, 1960).

Fifty-seven spectra of temperature, vapour pressure and
active index were computed from captive balloon data taken at elevations up to 3000 ft m.s.l. Eight spectra of refractive index were obtained using an aircraft equipped with a microwave refractometer. It was found that atmospheric stability apparently has a pronounced effect on the variation of turbulent intensity with height. Although the spectra of all three parameters generally approach a −5/3 power law at high wave-numbers, stability seems to have a controlling influence on spectral form at the low-frequency end of the wave number range studied. It is therefore concluded that methods of computing microwave scattered fields from the mean square dielectric perturbations and scale size obtained from the auto covariance are unreliable. The forms of the experimental auto covariances appear to be best represented by an exponential function or perhaps by a modified Bessel function of the second kind and 1/3 order. The temperature-humidity cospectrum may influence the shape of the refractive index spectrum, especially under unstable conditions. The equivalence of Eulerian space and time spectra is verified for refractive index by a series of aircraft-balloon fly-bys.

551.5

16478 IONOSPHERIC ELECTROSTATIC FIELDS AND THE EQUATORIAL ELECTROJET. A.J.Zmuda.

J. geophys. Res., Vol. 65, No. 8, 2247-53 (Aug., 1960).

The electrostatic characteristics associated with the equatorial electrojet are investigated with the aid of a number of theoretical and experimental considerations. With regard to the peak electrojet current, an eastward component of electric force of magnitude 4×10^{-4} V/m drives a current of density 10^{-5} A/m^2. In the region of maximum current the ionosphere is electrically neutral, but the electric field is created by an electrostatic charge distribution with an excess of electrons in the region east of the point with peak current and an excess of positive charges in the region to the west. The maximum of the difference in the number density of the negative and positive charges is 5×10^{-2} charge/m^3 for the volume density, and 9×10^4 charge /m^2 for the surface density on the lower boundary of the E layer. These number differences, which represent extremely small departures from electrical neutrality in the ionosphere, indicate the prime importance of a surface charge distribution in producing the ionospheric electrostatic field. The vertical component of the electrostatic force has a maximum value of 4×10^{-4} V/m but vanishes at the point containing the peak electrojet current.

551.5 : 621.391.821

16479 LIGHTNING DISCHARGES AS A SOURCE OF WHISTLERS. H.Norinder and E.Knudsen.

Ark Geofys., Vol. 3, Paper 11, 255-88 (1960).

A station for analysis of relations between lightning discharges and whistlers was operated near Uppsala. After preliminary tests in 1956-57 a definite programme was realized during the thunderstorm season of 1958. It was found that whistlers occur in groups — whistler situations — with periods often of ½ to 2½ hr, exceptionally of 5 to 6 hr. Whistlers sometimes occurred in great numbers for shorter periods of time between total cessations. These extended over hours, days and even weeks. Whistler situations on days with thunderstorms were located by a c.r.o. direction finder. It was found that whilst a thunderstorm in one direction produced whistlers, a simultaneous thunderstorm in another direction at about the same distance did sometimes not. Variations in the same thunderstorm of the electric field force from atmospherics related or not to whistlers resulted in that atmospherics with the highest field force were always followed by whistlers. This was explained partially by facilitated propagation for wave-packets in the low-frequency band around 50 kc/s and partially by high initial energy in the discharges causing whistlers. A comparison in the same thunderstorm of wave-forms from atmospherics not producing whistlers showed typically irregular variational forms and one single discharge in the lightning path. On the other hand, whistler-producing lightning discharges very often indicated multiple discharges in the path. By comparative harmonic analysis it was shown that whistler-producing lightning discharges were characterized by a preponderance of frequencies around 5-8 kc/s. Lightning discharges not followed by whistlers distinctly lacked preponderance of values in this frequency region.

551.5 : 621.391.821

16480 MULTIPLE LIGHTNING DISCHARGES FOLLOWED BY WHISTLERS. H.Norinder and E.Knudsen.

Ark. Geofys., Vol. 3, Paper 12, 289-98 (1960).

Time intervals of multiple lightning strokes which produced whistlers were analysed by a cathode-ray oscillograph. The time intervals of the corresponding multiple whistlers were determined by ensuing sonagrams. Within the limits of error a thorough agreement in time intervals is proved. A method is proposed for the analysis of multiple whistlers which originate from separate lightning paths and where whistlers propagate along different ducts.

551.5 : 621.316.98 : 621.391.821

16481 SYMPOSIUM ON SFERICS AND THUNDERSTORM ELECTRICITY. Edited by C.P.Mook.

J. geophys. Res., Vol. 65, No. 7, 1865-1966 (July, 1960).

This symposium was held in San Diego, California, U.S.A. in October 1959. Abstracts of the first eleven papers are published below, and titles of the remaining papers, which were given as short abstracts only, are as follows: - The role of continuous discharges in cloud-to-ground lightning, N.Kitagawa, M.Brook and E.J.Workman (p. 1965); Thunderstorm electrical discharges interpreted by aircraft and related ball lightning and sperics phenomena, M.M. Newman (p. 1966); Quasi-static electric field studies of thunderstorms, H.L.Jones, F.J.Bordeaux and W.D.Woodruff (p. 1966).

551.5 : 621.391.821

16482 ATMOSPHERICS FROM LIGHTNING FLASHES WITH MULTIPLE STROKES. E.T.Pierce.

J. geophys. Res., Vol. 65, No. 7, 1867-71 (July, 1960).

The atmospherics resulting from the individual return strokes of a multiple lightning discharge to earth are considered. Special attention is paid to the differences between the source spectra for first and subsequent strokes. It is shown that the change in the velocity of ascent of the return stroke, between a first and a following stroke, implies a shift of the spectrum toward to low-frequency end. On the other hand, the more rapid current rise associated with subsequent strokes entails an intensification of the higher frequencies. A combination of these effects suggests that the source spectrum is effectively constant for all strokes at frequencies exceeding 10 kc/s, and that the main differences occur below this frequency. A straightforward experimental method of checking these conclusions is outlined.

551.5 : 621.316.98

16483 A CONTRIBUTION TO THE ELECTROSTATIC THEORY OF A LIGHTNING DISCHARGE. H.W.Kasemir.

J. geophys. Res., Vol. 65, No. 7, 1873-8 (July, 1960).

The electrostatic treatment of the field and charge distribution of a lightning discharge leads to the result that the charge distribution of a lightning stroke is composed of (1) the influence charges induced by the electric field of the thundercloud with the net charge zero, and (2) the net charge, which results from the potential difference of the lightning stroke and the ground before the lightning hits the ground. The first kind of charge distribution is that of a cloud discharge and that of the first leader of a ground discharge. The second kind of charge distribution is a feature of the main or return stroke of a ground discharge only. It is the charge distribution of charged body and independent of the field distribution in the thundercloud. The well-known electrodynamic theory of transients on a transmission line can therefore be applied to the return stroke.

551.5 : 621.391.821

16484 HYPERBOLIC DIRECTION FINDING WITH SFERICS OF TRANSATLANTIC ORIGIN.

E.A.Lewis, R.B.Harvey and J.E.Rasmussen.

J. geophys. Res., Vol. 65, No. 7, 1879-1905 (July, 1960).

The experimental "hyperbolic direction-finder" consists of an array of sferic receivers in the New England area, connected by wide-band data links so that microsecond differences in pulse arrival time can be measured. The hyperbolic directions can be determined from the time differences. In a series of coordinated runs, individual sferics originating in western Europe were observed by both the New England net and the sferics net of the British Meteorological Office. The British Meteorological Office furnished the geographic coordinates of the lightning strokes so that measurements of position could be compared. Tabulated results for 150 sferics show an average absolute deviation from the mean of only 31 nautical miles.

551.5 : 621.316.98

16485 OBSERVATIONS OF ELECTRIFICATION AND LIGHTNING IN WARM CLOUDS.

C.B.Moore, B.Vonnegut, B.A.Stein and H.J.Survilas.

J. geophys. Res., Vol. 65, No. 7, 1907-10 (July, 1960).

An isolated warm cumulus cloud that never attained the altitude of the 0°C isotherm was observed to produce four strokes of lightning.

551.5 : 621.39

16486 SOME MEASUREMENTS OF ATMOSPHERIC NOIS LEVELS AT LOW AND VERY LOW FREQUENCIE CANADA. C.A.McKerrow.

J. geophys. Res., Vol. 65, No. 7, 1911-26 (July, 1960).

Atmospheric noise levels at 11, 35, and 135 kc/s were rec at Ottawa and Churchill for a period of 1 year beginning Septen 1958. A statistical analysis of the noise as a function of freque time of day, and season of the year has shown the following:(1) same noise storms determine the noise levels received at both locations (since the beginning of the midday maxima occurs at same time, whereas local time differs by 1 hour, and the depar of the daily median from the monthly median varies in a regula way and is the same at both locations); (2) the noise level decre with increase of frequency more rapidly than predicted by C.C. (especially in winter when the noise storm centres are most di (3) the morning decrease in noise level varies in a regular way the year, as expected from the sunrise time, between the recei and the location of the most active storm centres; (4) the equip measures both r.m.s. and the average noise levels. Only at the frequency during the winter season is a regular daily variation obtained.

551.5 : 621.31

16487 ELECTRIC-FIELD CHANGES AND THE DESIGN O LIGHTNING-FLASH COUNTERS.

M.Brook and N.Kitagawa.

J. geophys. Res., Vol. 65, No. 7, 1927-31 (July, 1960).

Examples of electric-field and field-change records of ligh ning discharges are discussed in relation to the design of lightnin flash counters. Correlations between stroke counts and visual observations of nocturnal lightning were found to be very poor f a stroke counter that operates on the abrupt-field change princi The abrupt field changes of both signs that accompany all lightni discharges make it virtually impossible to discriminate between ground and cloud flashes with stroke counters of the conventiona type. A reliable total count for nocturnal lightning of both types can be obtained with a photomultiplier tube. A photomultiplier operated in coincidence with an electric-field change meter can utilized to discriminate against sferics and man-made interfere Conversely, if the photomultiplier and field-change meter are op rated in anticoincidence, a trigger system can be constructed wh will accept only sferics that originate from outside the area of visible lightning discharges.

551.5 : 538.56 : 621.391.

16488 V.L.F. ATTENUATION FOR EAST–WEST AND WEST–EAST DAYTIME PROPAGATION USING ATMOSPHERICS. W.L.Taylor.

J. geophys. Res., Vol. 65, No. 7, 1933-8 (July, 1960).

Daytime attenuation characteristics were computed by comparing the amplitude spectra of atmospheric waveforms recorde at four widely separated stations. The results of these attenuati measurements are presented for the band of frequencies from 3 30 kc/s and involving distances of 1000 to 10 000 km. Nonrecipr city is evident from this study. Attenuation rates over sea water for east-to-west propagation were about 3 dB/1000 km greater f frequencies below 8 kc/s, and about 1 dB/1000 km greater for frequencies above 10 kc/s, than for west-to-east propagation. East-to-west attenuation rates over land were about 1 dB/1000 greater than for over sea water.

551.5 : 621.391.

16489 ON THE THEORY OF THE SLOW-TAIL PORTION O ATMOSPHERIC WAVEFORMS. J.R.Wait.

J.geophys. Res., Vol. 65, No. 7, 1939-46 (July, 1960).

The propagation of the slow-tail portion of atmospherics is c sidered from the waveguide-mode viewpoint. The source, which is a lightning discharge, is represented by a vertical dipole. The transient response of the distant electric field is then computed for various forms of the source current waveform. The results are then employed to reinterpret the experimental data of Hepbur (J. atmos. terrest. Phys., Vol. 10, 266-87, 1957). As suggested by the present theory it is found that the observed separation t_s between the oscillatory head of the atmospheric and the maximum of the slow-tail amplitude varies with distance ρ to the source according to a law of the form $(t_s)^{1/2} = A + B_{\rho}$. The constant A is related to the pulse width of the source, and the constant B depen on ionospheric parameters. Values of effective ionospheric cond tivities deduced from the theory are consistent with earlier resul for the v.l.f. band. The influence of nonvertical currents in the discharge channel is also briefly discussed.

551.5 : 621.316.98

490 BALL LIGHTNING AS A PHYSICAL PHENOMENON.
E.L.Hill.

ophys. Res., Vol. 65, No. 7, 1947-52 (July, 1960).

Ball lightning has not been produced in the laboratory as yet, s existence as a real natural phenomenon seems to be assured. evidence concerning its physical nature is reviewed in the light own information on atmospheric electricity and the lightning arge. It is concluded that it is unlikely that ball lightning is sma phenomenon, as it is frequency assumed to be. More ably it is a region containing a strongly inhomogeneous distri- n of space charge in the form of highly ionized gas, the ioni- n being primarily in the molecular form, with few free rons. Occluded material such as dust, water vapour, and ustible gases may play a significant role in its behaviour.

551.5 : 621.316.98

491 SOME ELECTROSTATIC CLOUD-DROPLET COLLISION EFFICIENCIES.
J.D.Sartor.

ophys. Res., Vol. 65, No. 7, 1953-7 (July, 1960).

Recent electrostatic and hydrodynamic solutions to the two-body lem of the forces on neighbouring spheres are combined to rmine the motion of cloud droplets in a uniform electrostatic . Collision efficiencies are obtained from the relative tra- ories of one droplet with respect to another both with and with- he electrostatic field. The collision efficiencies are compared emonstrate the effect of electrostatic fields in the initial stages roplet accretion. It is concluded that fields commonly observed ouds can play an important role in the collision and coalescence e droplets.

551.5 : 537.3 : 621.391.821

6492 AIRPLANE INSTRUMENT FOR MEASUREMENT AND VECTORIAL PRESENTATION OF ELECTRICAL TENTIAL GRADIENT.
B.Vonnegut and D.A.McCaig.

eophys. Res., Vol. 65, No. 7, 1959-63 (July, 1960).

Apparatus is described that measures simultaneously all three ponents of the atmospheric potential gradient and presents the ultant vector on cathode ray oscilloscopes.

551.5

16493 SWEEPERS.
N.C.Gerson and W.H.Gossard.

tmos. terrest. Phys., Vol. 17, No. 1-2, 82-5 (Dec., 1959).

The time-frequency traces of atmospherics ("sweepers") have n studied in 500 kc/s bands about various observing frequencies he range 1-30 Mc/s. The principal activity is found in the 26½ Mc/s region. The atmospherics aften occur in trains h an approximately constant period between successive eepers. Periods from 4 to 140 seconds have been observed, also rain lasting 477 seconds which still had not terminated at the end he test.
D.M.Gilbey

551.5

16494 A FURTHER NOTE ON "SWEEPERS".
J.M.Watts.

tmos. terrest. Phys., Vol. 18, No. 1, 81 (April, 1960).

See preceding abstract. An additional interesting feature was erved. Many of the signals, as they swept through the receiver s-band, were observed to be modulated, having the characteristic nd of a poorly filtered plate supply. Analysis by a sound spectro- ph of a few of then showed the modulation frequencies to be pre- ninantly even harmonics of 60 c/s, which would be expected from ll-wave rectifier operating from a North American power line. s additional feature of the observations puts an entirely different t on the phenomenon. It seems unlikely that it can be explained a newly discovered natural phenomenon.

551.5

16495 THE CURRENT-JET HYPOTHESIS OF WHISTLER GENERATION.
W.C.Hoffman.

J. geophys. Res., Vol. 65, No. 7, 2047-54 (July, 1960).

It is postulated that at least some types of whistler signals, e.g., "long trains", are generated by synchronous interaction between an energetic upward discharge from the top of a thundercloud and the extraordinary component of a sferic that lags the discharge by a time of the order of a second. The nature of the overall generation mechanism is outlined, and the evidence for each phase is reviewed. An elementary theory of the synchronous interaction is stated.

551.5

16496 NEW FISSION PRODUCTS IN THE ATMOSPHERE.
V.Mageru, D.Blânariu and I.Gabe.

Naturwissenschaften, Vol. 47, No. 14, 319 (1960). In German.

Observations at Jassy show an increase in radioactivity at the end of February 1960. This is attributed to the explosions in the Sahara.
J.M.Hough

551.5

16497 CONCENTRATION OF PARTICULATE AIR-BORNE FISSION PRODUCTS AT GROUND LEVEL IN CANADA DURING I.G.Y.
J.L.Wolfson and F.Terentiuk.

Canad. J. Phys., Vol. 38, No. 8, 991-1010 (Aug., 1960).

Daily measurements are reported of the concentration of air-borne fission products at ground level in Canada during the period from late 1957 to the end of March 1959. The measurements, conducted at 14 stations throughout Canada, were part of the Canadian programme for the International Geophysical Year and International Geophysical Co-operation. The results are given in the form of charts for each of the 14 stations, and monthly averages for each of the stations are tabulated.

551.5

16498 ON THE SIMULTANEOUS MEASUREMENT OF THE ACTIVITY DUE TO RADON AND ITS DECAY PRODUCTS IN THE ATMOSPHERE. THE POSSIBLE APPLICATION TO URANIUM PROSPECTING AT A DISTANCE.
D.Blanc, J.Fontan and G.Vedrenne.

C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4349-51 (June 27, 1960). In French.

Describes an apparatus for the continuous measurement of the activity due to radon and its decay products in the atmosphere. Air is drawn through a paper filter which is continuously moving and passes by a scintillation counter. The speed of movement of the filter is such that the activity collected is 40% of the equilibrium value for radon products but only 2% for thoron products. The output of the counter is connected to a recorder. It should be possible to determine the approximate location of uranium ore deposits from a measurement of activity deposited on the filter and a knowledge of the wind speed and direction. The author suggests a limit of 200 km to the distance at which a survey would be possible with the apparatus described.
R.H.Thomas

551.5 : 550.3

GEOPHYSICAL EFFECTS ASSOCIATED WITH THE HIGH-ALTITUDE NUCLEAR EXPLOSION. See Abstr. 16412

551.5 : 539.17 : 538.56

ELECTROMAGNETIC SIGNALS FROM NUCLEAR EXPLOSIONS IN OUTER SPACE: SENSITIVE MEANS OF MEASURING ELECTRON DENSITY. See Abstr. 15136

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

576.2

16499 DYNAMICS OF THE VIBRATION SENSE AT LOW FREQUENCY. E.Eijkman and A.J.H.Vendrik.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1134-9 (Sept., 1960).

The dynamic properties of the vibration sense in the human skin were investigated by means of psycho-physical methods using stimuli with different time courses. Sinusoidal deformations and deformations linearly increasing with time were used. Up to frequencies of 30 c/s the results are described very well by a differentiating system having a time constant of about 30 msec. This is in good agreement with electro-physiological observations. Also in agreement with eletrophysiological experiments "rectifying" properties are found. Possible mechanisms underlying these phenomena are discussed.

61 : 621.389 : 621.386.8

16500 ELECTRONIC SWITCHING OF THE EXPOSURE TIMES IN X-RAY APPARATUS. A.Pfahnl.

Z. angew. Phys., Vol. 12, No. 7, 329-34 (July, 1960). In German.

Reviews the advantages and application of electronic control of exposure time of diagnostic X-ray tubes especially for successive exposures each lasting for only a matter of milliseconds. The principal circuits that were evolved to meet this need are described. It is pointed out that some of these circuits have the additional advantage of stabilizing the tube voltage. T.Mulvey

61 : 621.317.39

16501 INTRACARDIAC CATHETER TIP PIEZORESISTIVE PRESSURE GAUGE.

M Traite, W.Welkowitz and R.Downs.

Rev. sci. Instrum., Vol. 31, No. 9, 987-91 (Sept., 1960).

A pressure gauge is described that can be encased in a small-bore plastic catheter. The small size permits insertion directly into the heart. The unit uses a two-section piezoresistive element, operated as a cantilever. The sensitivity of the gauge is $0.16\ \mathrm{mV\ V^{-1}}$ per lb $\mathrm{in^{-2}}$ and the frequency response is flat from 0 to 400 c/s.

Hearing . Speech

612.8

16502 THEORY OF SIGNAL DETECTABILITY AS AN INTERPRETIVE TOOL FOR PSYCHOPHYSICAL DATA.

W.P.Tanner, Jr.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1140-7 (Sept., 1960).

It is concluded that the assumption that the observer attempts to maximize the expected value of the outcome of the experiment is correct, and that a set of physical conditions can be established which justify a computation of the detectability of a signal in noise based on a finite sampling plan involving 2WT amplitude values over the open interval, 0 to T.

612.8

16503 WORKING MODEL ILLUSTRATING THE CROSS-SECTION OF THE COCHLEA MECHANICALLY.

M.F.Meyer.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1158-9 (Sept., 1960).

This model shows what hypothetically happens crosswise in the cochlea. It is made of dry ties of several materials, not of tubing filled with a liquid.

612.8

16504 MECHANICAL MODEL FOR THE DEMONSTRATION OF THE MOVEMENT OF BASILAR MEMBRANE. L.Cremer.

Acustica, Vol. 8, No. 4, 188-92 (1958). In German.

A demonstration model of the dynamic action of the inner ear, based on a mechanical filter system, is described. Compared with other models it has the advantage that it can be operated by hand and that its frequency range (0.5 to 8 c/s) is so low that the motion of waves along the basilar membrane can be clearly followed.

612.8

16505 FRONT-BACK DISCRIMINATION OF THE HEARING SYSTEM. J.F.Burger.

Acustica, Vol. 8, No. 5, 301-2 (1958).

Tests were carried out in an anechoic chamber to determine whether head movements and directional characteristics of the outer ear were sufficient to explain an observer's ability to discriminate between signals from the front and from behind. The results obtained, especially at lower frequencies, seem to indica that these two factors alone do not explain the phenomenon compl

6

16506 PERCEPTION OF ARTIFICIAL ECHOES OF MEDIU DELAY. P.Dubout.

Acustica, Vol. 8, No. 6, 371-8 (1958).

A simplified criterion of echo perception is formed, based c momentary masking of the echo by the signal, the masking at fir being assumed to depend only on momentary relative intensity. The criterion is expressed as a special correlogram of signal ar echo levels, which specifies the attenuation required to suppress the echo to the threshold of perceptibility, as a function of echo delay. Subjective thresholds of discrete echo perception are obtained experimentally using speech, music and bursts of noise echo delays from 25 ms to 400 ms. A high speed level comparat is used to derive the correlograms of the same combinations of signal and echo. Agreement between the subjective thresholds ar correlograms is good. For signals having peaks which decay ve rapidly, there is a systematic divergence of results which is attributed to the difference between the transient response of the subjects' hearing and that chosen for the comparator.

61

16507 EXPERIMENTAL STUDY OF THE RELATIVE INTELLIGIBILITY OF ALPHABET LETTERS.

E.T.Curry, T.H.Fay, Jr, and C.L.Hutton.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1151-7 (Sept., 1960).

Twenty-six individual spoken alphabet letters were presente normal listeners over a 45 dB range of levels. The gain function for the pooled results of 26 letters spoken by three experienced speakers to 18 listeners has a sigmoidal shape. The 15 dB incre in presentation level from 10 to 25 dB yields a 65% increase in correct identification for all letters. The average slope of the po curve for all letters between 20 and 80% was 4.34% per dB. The curves appear to be similar to those of the more difficult stimuli such as the monosyllable PB lists and unselected disyllabic lists. Percentages of correct identifications for each letter at each pres tation level are also presented.

61

16508 COMPENSATORY AND PURSUIT TRACKING OF LOUDNESS. A.G.Pikler and J.D.Harris.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1129-33 (Sept., 1960).

In the compensatory form of loudness tracking, the subject (keeps a loudness level constant in the face of programmed chang in the pursuit form, he duplicates the loudness changes by manip ating an external source. Five subjects were required to track th tape-recorded programmes presented in eight test conditions, incl both modes (compensatory and pursuit) and three channel types o reception (monotic, diotic, dichotic). The responses were obtaine by dial-writing techniques and a paper-tape voltage recorder. Analysis of variances based on 120 tracings revealed the overall superiority of the compensatory mode (averaged momentary erro 2.2 dB) versus the pursuit mode (3.3 dB). High accuracy and consistency obtainable in auditory tracking suggest its use for the purposes of suprathreshold audiometry and for human engineerin tasks in compensatory and pursuit displays.

61

16509 FREQUENCY MEASURE OF THE E.E.G. F.J.Norkus, A.J.Derbyshire, P.J.Mills and R.L.Carte

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1147-50 (Sept., 1960).

The use of electroencephalograms for the evaluation of audito function have proven to be invaluable, especially where the standa audiogram is not possible. In sleeping subjects there is a definab change in the EEG pattern upon the presentation of an auditory stimulus. One method of analysis of the brain's response to a ton is the measurement of shifts in frequency of the brain wave, recor simultaneously with the electroencephalogram. This recording of frequency changes is later analysed for indications of reception of the tones presented. An electronic frequency recorder which is used in conjunction with a standard polygraph is described. The cortex has indicated a response when the recorder produces a shi in frequency. This shift occurs within a specified time interval af the presentation of tone (the "delay time" of the response).

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Brit. Pwr Engng	British Power Engineering George Newnes, Tower House, Southampton Street, London, W.C.2.
Bull. Amer. Phys. Soc.	Bulletin of the American Physical Society Columbia University, New York 27, N.Y.
Rev. Elect. Commun. Lab. (Tokyo)	Review of the Electrical Communication Laboratory (Formerly: Reports of the Electrical Communication Laboratory) The Electrical Communication Laboratory, Nippon Telegraph and Telephone Public Corporation, 1551 Kitizyôzi, Musasino-si, Tokyo.

CHANGE OF TITLE

Rep. Elect. Commun. Lab. (Tokyo)	Reports of the Electrical Communication Laboratory Title changed to: Review of the Electrical Communication Laboratory [Rev. Elect. Commun. Lab. (Tokyo)] with issue dated Jan.-Feb., 1960.

ERRATA

Author Index (1950) p. 1192, column 2, Zener,C.: for "3418" read "3415"
Author Index (1959) p. 1462, column 2: after "Neu,H." insert "Neubauer,F.R. and Fokker,A.D. The polarisation of solar radio emission at a frequency of 200 MHz, 5308"
Abstr. 8733 (1960) line 4: delete "Space Research Discussion, London, 1958 (See Abstr. 8522 of 1960)"
Abstr. 10307 (1960) line 6: for "F.W.Cockow" read "F.W.Cuckow"
Abstr. 12931 (1960) line 3: for "M.J.Moravisik" read "M.J.Moravcsik"
Abstr. 13458 (1960) line 2: for "J.Riddell, Jr" read "R.J.Riddell, Jr"
Abstr. 13490 (1960) line 14: for "M.E.Priestley" read "M.G.Priestley"
Abstr. 13536 (1960) line 5: for "A.D.Belyaeu" read "A.D.Belyaev"
Abstr. 13830 (1960) line 12: for "M.E.Priestley" read "M.G.Priestley"
Abstr. 13940 (1960) line 3: for "A.I.Roitburg" read "A.I.Roitburd"
Abstr. 14001 (1960) line 4: for "Lane" read "Laue"
Abstr. 14058 (1960) line 5: for "pressure" read "presence"
Author Index (July, 1960): for "Cockow,F.W., 10307" read "Cuckow,F.W., 10307"
Author Index (July, 1960): for "Kelemens,P.G., 9934" read "Klemens,P.G., 9934"
Author Index (July, 1960): after "Băbuţia,I." for "8641" read "8640"
after "Borneas,M." for "8641" read "8640"
after "Dzyaloshinskii,I.E." for "8636" read "8641"
after "Lifshitz,E.M." for "8636" read "8641"
after "Pitaevskii,L.P." for "8636" read "8641"
after "Rosen,G." for "8640" read "8639"
after "Taylor,G." for "8637-9" read "8636-8"

UNIVERSAL DECIMAL CLASSIFICATION

In this volume of "Physics Abstracts", the Universal Decimal Classification numbers printed with each abstract are much briefer than in former volumes. This was announced in the January issue, and the comments of readers on the usefulness of these numbers were requested.

Very few comments indeed have been received up to the present time. A particular request is therefore made to readers to study the announcement on the first page of the January, 1960, issue, and to supply their observations as soon as possible. The procedure to be followed in next year's volume will be determined in the light of the comments received.

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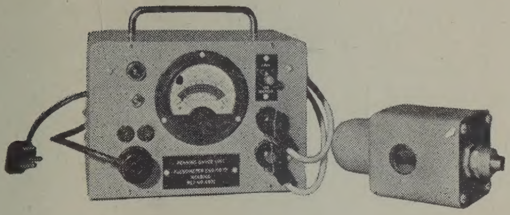

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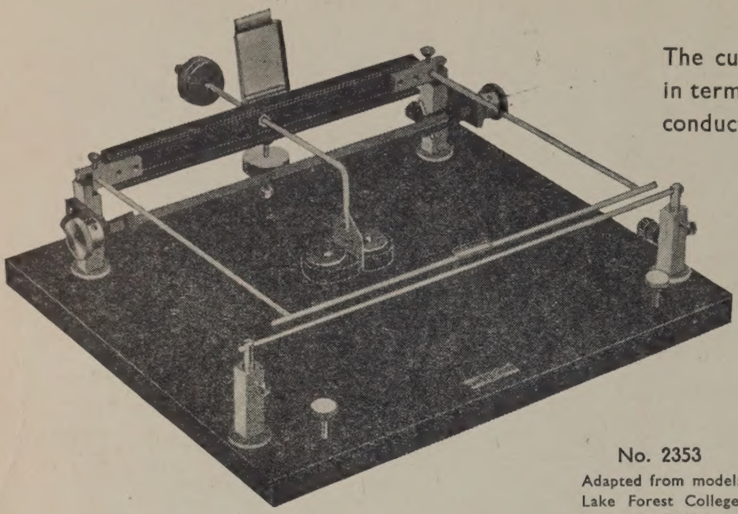

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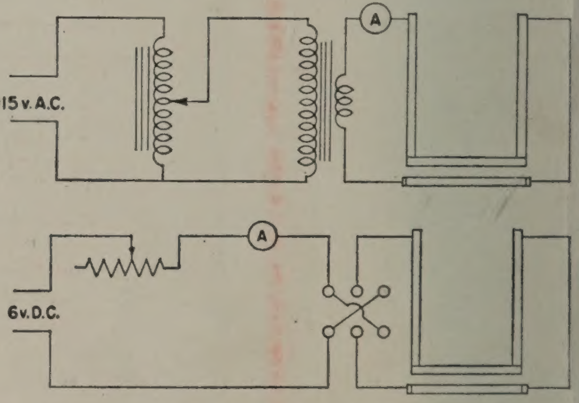

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